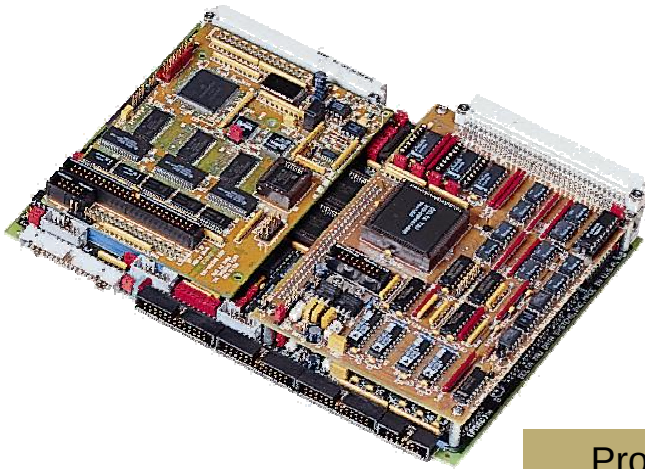


# HARDWARE REFERENCE MANUAL

## PMAC2-VME



Programmable Multi-Axis Controller

3Ax-602413-xHxx

May 27, 2004



**DELTA TAU**  
Data Systems, Inc.

*NEW IDEAS IN MOTION ...*

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## **INTRODUCTION**

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The PMAC2 VME provides state-of-the-art motion control for a wide variety of applications, including machine tools, robotics, semiconductor manufacturing, packaging equipment, and general-purpose automation. It utilizes the latest developments in electronics, software, and modern control theory to bring motion control capabilities to a whole new level.

The PMAC2 VME is designed as a bus expansion card, but is capable of standalone operation. It is VMEbus-compatible, with two slots and four or eight machine interface channels.

## **Features**

---

PMAC2 VME supports a wide variety of servo and stepper interfaces:

- Analog +/-10V velocity command (requires Acc-8E or equivalent)
- Analog +/-10V torque command (requires Acc-8E or equivalent)
- Sinusoidal analog +/-10V phase current commands (requires Acc-8E or equivalent)
- Direct digital pulse-width modulated (PWM) phase voltage commands (requires Acc-8F, -8K or equivalent)
- Pulse-and-direction commands (requires Acc-8S or equivalent)
- MACRO™ ring network commands (requires Acc-42)

PMAC2 VME also provides unparalleled speeds and resolutions:

- 40 MHz encoder count rate
- 18-bit analog outputs
- 18 microsecond per axis servo update time (60 MHz)
- 120 MHz PWM clock frequency (10-bit resolution at 120 kHz, 12-bit and 30 kHz, 14-bit at 7.5 kHz)
- 120 MHz MLDT (e.g. Temposonics™) timer frequency (0.024mm, 0.9mil resolution)
- 10 MHz maximum pulse-and-direction output frequency
- 10 MHz maximum position-compare output update rate
- 125 Mbit/sec optical ring network data rate

## **PMAC2 VME Configuration**

---

A PMAC2 VME board can have one or two DSPGATE1 ASICs; the first one is standard, and the second one comes if Option 1V is ordered. It also has a DSPGATE2 ASIC supporting the non-servo I/O.

## **PMAC2 VME ASICs**

Delta Tau has designed its own custom application-specific integrated circuits (ASICs) for the PMAC2 VME using the latest sub-micron gate-array technology. Each ASIC contains 45,000 active logic gates. These ASICs contain all of the digital interface circuitry to tie the DSP to the machine; the rest of the circuitry on the board is buffer circuitry.

## **DSPGATE1 Servo ASIC**

The DSPGATE1 ASIC contains the digital servo interface circuitry for four channels, usually sufficient for four axes of control. Each channel contains:

- Three command output sets:
- Top-and-bottom PWM or serial DAC data with clock
- Top-and-bottom PWM or serial DAC data with strobe
- Top-and-bottom PWM or PFM pulse-and-direction
- Encoder quadrature or pulse-and-direction decode and count
- Index channel input internally gated to 1 quadrature state wide
- Four flags with capability to perform hardware latching of encoder position
- HOME, PLIM, MLIM, USER
- Double-sided position-compare output with auto-increment capability
- Amplifier enable output

- Amplifier fault input
- Four supplementary flag inputs (T, U, V, W)
- Two inputs from serial analog-to-digital converters (ADCs)
- ADC clock and strobe signal outputs

The DSPGATE1 ASIC also generates several clock frequencies necessary for hardware and software operation, under the user's software control:

- PWM output frequency
- DAC clock frequency
- ADC clock frequency
- Encoder sample clock frequency
- Pulse-frequency modulation (PFM) clock frequency
- Phase interrupt clock frequency
- Servo interrupt clock frequency

---

**Note:**

Phase interrupt clock frequency and Servo interrupt clock frequency are generated from the first DSPGATE1 only.

---

## DSPGATE2 I/O ASIC

There is also a DSPGATE2 ASIC on PMAC2 VME, which is used for interface to other I/O. The DSPGATE2 ASIC has three parts:

- General-purpose digital I/O: 56 I/O points for JIO, JTHW, and JDISP ports
- Servo interface circuitry for 2 supplemental channels with clock generation
- MACRO ring interface circuitry

Generally, the general-purpose I/O and the servo interface circuitry on the DSPGATE2 share pins, except for two 2-channel encoder inputs and two PWM/PFM output sub-channels. On a PMAC2 VME board, usually the shared pins are used for general-purpose I/O instead of extra servo interface circuitry, but this is up to the individual user.

## PMAC2 VME Board Configuration

---

Jumpers on the PMAC2 VME determine the frequency at which the DSP on the PV CPU board will operate. The 56002 DSP has a phased-locked loop (PLL) that allows it to multiply the crystal frequency by a programmable integer value, permitting very high CPU frequencies with a moderate crystal frequency. The crystal frequency on the PV CPU board is always 19.6608 MHz, commonly called 20 MHz.

The component rating of the DSP IC specifies the highest frequency at which it safely can run, but it is the multiplication factor typically set by jumpers that specifies the frequency at which it actually runs. Usually this is a frequency at or near the maximum for the component.

It is safe to run a DSP at a frequency below the maximum. It may be possible to run a DSP at a frequency higher than its maximum frequency, particularly at low ambient temperatures, but safe operation cannot be guaranteed. Unpredictable and possibly dangerous operation may result.

On power-up/reset, the DSP, operating at the crystal frequency of 20 MHz, reads the frequency jumpers (E2 and E4) and writes into its own PLL multiplier register at X:\$FFFD. Bits 0-3 of this word contain a value one less than the multiplier value (if the frequency is being multiplied by 3, these bits contain a value of 2).

If you wish to check the value of your multiplier, you can use the on-line command RHX:\$FFFD and look at the last hexadecimal digit. The actual multiplier is one greater than the value in this last digit.

Alternately, you can define an M-variable such as M99->X:\$FFFD,0,4 and then read from or write to these bits with the M-variable.

## PMAC2 VME Setup

On PMAC2 VME, jumpers E2 and E4 control the frequency of operation of the DSP according to the following table:

| E2  | E4  | X:\$FFFD; 0-3 | True Multiplier | DSP Frequency |
|-----|-----|---------------|-----------------|---------------|
| OFF | OFF | 1             | x2              | 40 MHz        |
| ON  | OFF | 2             | x3              | 60 MHz        |
| OFF | ON  | 3             | x4              | 80 MHz        |

On the PMAC2 VME, I54 is read at power-up to set the baud rate clock. Because this clock is derived from the CPU clock frequency, the proper setting of I54 is dependent on the CPU clock frequency as set by E2 and E4. Table 1-3 shows the settings of I54 for 40, 60, and 80 MHz CPU operation.

| I54 | Baud Rate for 40 MHz CPU | Baud Rate for 60 MHz CPU | Baud Rate for 80 MHz CPU |
|-----|--------------------------|--------------------------|--------------------------|
| 0   | 600                      | Disabled                 | 1200                     |
| 1   | 900* (-0.05%)            | 900                      | 1800* (-0.1%)            |
| 2   | 1200                     | 1200                     | 2400                     |
| 3   | 1800* (-0.1%)            | 1800                     | 3600* (-0.19%)           |
| 4   | 2400                     | 2400                     | 4800                     |
| 5   | 3600* (-0.19%)           | 3600                     | 7200* (-0.38%)           |
| 6   | 4800                     | 4800                     | 9600                     |
| 7   | 7200* (-0.38%)           | 7200                     | 14,400* (-0.75%)         |
| 8   | 9600                     | 9600                     | 19,200                   |
| 9   | 14,400* (-0.75%)         | 14,400                   | 28,800* (-1.5%)          |
| 10  | 19,200                   | 19,200                   | 38,400                   |
| 11  | 28,800* (-1.5%)          | 28,800                   | 57,600* (-3.0%)          |
| 12  | 38,400                   | 38,400                   | 76,800                   |
| 13  | 57,600* (-3.0%)          | 57,600                   | 115,200* (-6.0%)         |
| 14  | 76,800                   | 76,800                   | 153,600                  |
| 15  | Disabled                 | 115,200                  | Disabled                 |

\* not an exact baud rate

## PMAC2 CPUs

The PMAC2 VME CPU communicates with the axes through specially designed custom gate array ICs, referred to as DSPGATES. Each of these ICs can handle four analog output channels, four encoders as input, and four analog-derived inputs from accessory boards. One PMAC2 VME can utilize from one to four of these gate array ICs, so specifying the hardware configuration amounts to counting the numbers and types of inputs and outputs. Up to 16 PMAC2 VMEs may be ganged together with complete synchronization, for a total of 128 axes. A PMAC2 VME may have one of three available CPU configurations. These configurations are described in the following paragraphs.

- P/N 602398 — This is the original standard CPU board for the PMAC2 VME. It has a 20MHz clock and a battery backup RAM.
- P/N 602405 — This is a flash memory CPU board with no battery backup. This board provides either a 40MHz or 60MHz clock.
- P/N 602705 — The PV CPU piggyback board provides 80 MHz CPU operation and supplemental battery-backed RAM for the PMAC2 VME.

The PV CPU board gets its name from the PV package style of the Motorola 56002 DSP IC on the board. The board is also called the Universal CPU because it can support all speeds and configurations of the CPU section.

The PV CPU has operational differences from earlier CPU configurations to support the new features. The following paragraphs explain these differences and are only relevant if using the 602705 CPU piggyback board on the controller.

## Configurations

The PV CPU board is configured at the factory to the customer's specifications. The JEXP expansion port is buffered, providing the capability to connect many boards on the expansion port.

The following table shows the configuration of the key components on the PV CPU board for the PMAC2 VME.

| Version  | Main Memory Backup | U6, U9, U15 Components | U7, U10, U16 Components | U5 Components | BT1 Components |
|----------|--------------------|------------------------|-------------------------|---------------|----------------|
| Standard | Flash              | Empty                  | 32-pin RAM              | Flash ROM     | Empty          |
| Opt 5B   | Flash              | Empty                  | 32-pin RAM              | Flash ROM     | Empty          |
| Opt 5C   | Flash              | Empty                  | 32-pin RAM              | Flash ROM     | Empty          |
| +Opt 16  | Flash              | 28-pin RAM             | 32-pin RAM              | Flash ROM     | Battery        |

## Firmware

The PV CPU board does not support firmware versions previous to V1.16 of August 1996 without changes in programming of the on-board logic (GALs). If the firmware must be changed between a version previous to V1.16 and a version V1.16 or newer, the on-board logic must be re-programmed.

When loading new firmware into the flash configurations of the PV CPU, E4 on the CPU board must be ON in addition to having the PMAC2 VME re-initialization jumper E3 ON.

## Option 16 Supplemental Memory

If the Option 16 supplemental battery-backed parameter memory is ordered, an extra bank of memory with battery backup circuitry is provided. This option can be ordered only if the main memory is flash backed (Option 4A, 5A, 5B, or 5C). This memory is for user parameter storage only. From PMAC programs it can be accessed with M-variables only (L-variables also in compiled PLCs). The on-line direct-memory read and write commands can be used from the host computer as well.

With M-variable access, arrays can be created with indirect addressing techniques by pointing a second M-variable to the definition of a first M-variable that points into this memory area. For example, with the M-variable definitions:

```
M0->L:$A000; 1st long word of Opt. 16 RAM; floating point
M10->Y:$BC000,0,16; Low 16 bits of M0 def., with pointer address
```

---

### Note:

---

This technique is not possible with L-variables in compiled PLCs.

---

The following code segment could load a sine table into the first 360 words of the Option 16 RAM:

```
P1=0
WHILE (P1<360)
    M10=$A000+P1    ; Sets address that M0 points to
    M0=SIN(P1)      ; Puts value in register that M0 points to
    P1=P1+1
ENDWHILE
```

Physically, the Option 16 memory is a 16k x 24 bank of battery-backed static RAM. It maps into the PMAC2 VME at addresses \$A000 to \$BFFF, on both the X and Y data buses, an 8k x 48 block of address space. Addresses Y:\$BC00 to Y:\$BFFF are double-mapped with the main flash-backed RAM for the M-variable definitions, and should not be used for user parameter storage.

Any value written into the Option 16 memory will automatically be retained through a power-down or reset; no **SAVE** operation is required. The power draw on the battery is low enough that battery life will typically be limited only by the quoted 10-year life of the battery.

## **Related Technical Documentation**

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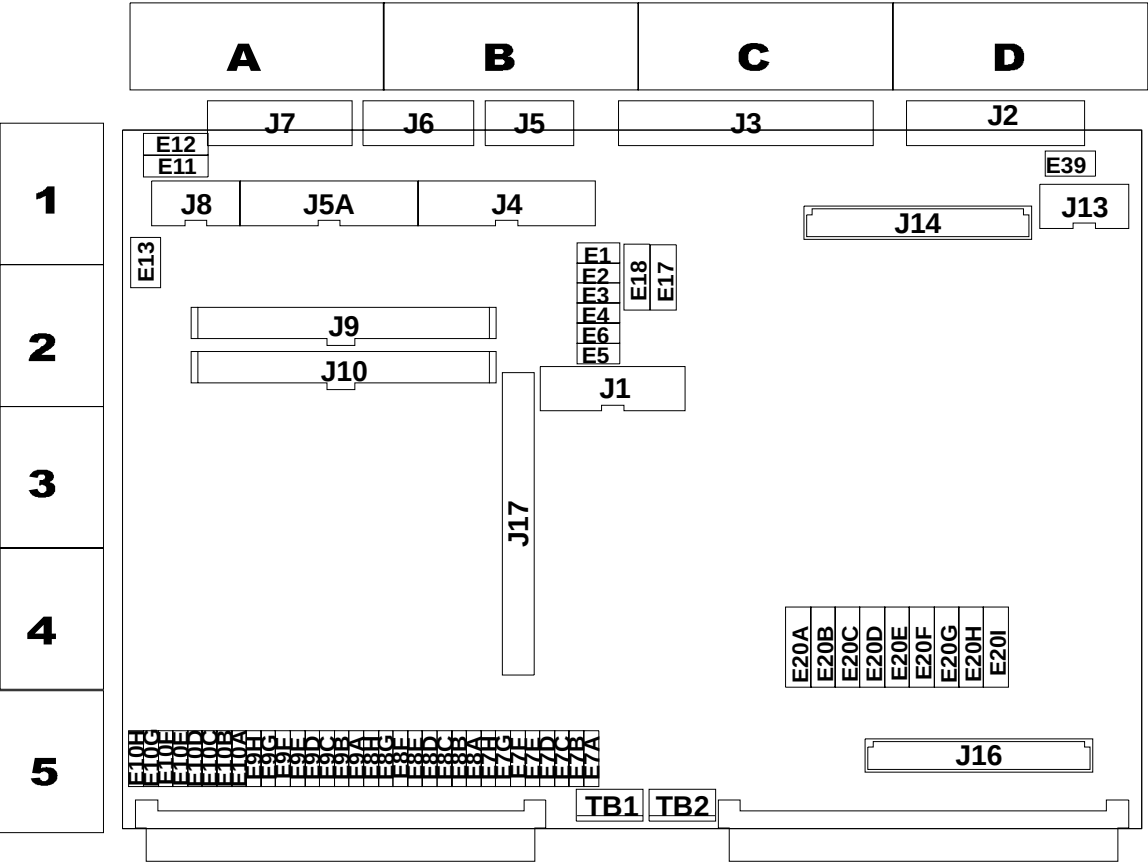
| <b>Manual Number</b> | <b>Manual Title</b>            |
|----------------------|--------------------------------|
| 3A0-602413-363       | PMAC2 User's Manual            |
| 3A0-602XXX-363       | PMAC User's Software Reference |

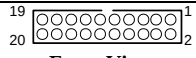


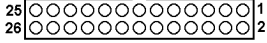
# CONNECTORS

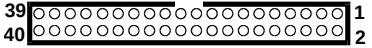
## PMAC2 VME Connector Summary

The following paragraphs provide a brief description of each connector on the PMAC2 VME, its use, and individual pinout information.

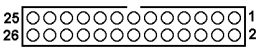


| J1/JANA (20-Pin Header)                                                                                                                                                                                                                                              |        |          |                         | <br>Front View |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------|-------------------------|---------------------------------------------------------------------------------------------------|
| Pin #                                                                                                                                                                                                                                                                | Symbol | Function | Description             | Notes                                                                                             |
| 1                                                                                                                                                                                                                                                                    | ANAI00 | Input    | Analog Input 0          | 0-5V or +/-2.5V range                                                                             |
| 2                                                                                                                                                                                                                                                                    | ANAI01 | Input    | Analog Input 1          | 0-5V or +/-2.5V range                                                                             |
| 3                                                                                                                                                                                                                                                                    | ANAI02 | Input    | Analog Input 2          | 0-5V or +/-2.5V range                                                                             |
| 4                                                                                                                                                                                                                                                                    | ANAI03 | Input    | Analog Input 3          | 0-5V or +/-2.5V range                                                                             |
| 5                                                                                                                                                                                                                                                                    | ANAI04 | Input    | Analog Input 4          | 0-5V or +/-2.5V range                                                                             |
| 6                                                                                                                                                                                                                                                                    | ANAI05 | Input    | Analog Input 5          | 0-5V or +/-2.5V range                                                                             |
| 7                                                                                                                                                                                                                                                                    | ANAI06 | Input    | Analog Input 6          | 0-5V or +/-2.5V range                                                                             |
| 8                                                                                                                                                                                                                                                                    | ANAI07 | Input    | Analog Input 7          | 0-5V or +/-2.5V range                                                                             |
| 9                                                                                                                                                                                                                                                                    | ANAI08 | Input    | Analog Input 8          | 0-5V or +/-2.5V range (1)                                                                         |
| 10                                                                                                                                                                                                                                                                   | ANAI09 | Input    | Analog Input 9          | 0-5V or +/-2.5V range (1)                                                                         |
| 11                                                                                                                                                                                                                                                                   | ANAI10 | Input    | Analog Input 10         | 0-5V or +/-2.5V range (1)                                                                         |
| 12                                                                                                                                                                                                                                                                   | ANAI11 | Input    | Analog Input 11         | 0-5V or +/-2.5V range (1)                                                                         |
| 13                                                                                                                                                                                                                                                                   | ANAI12 | Input    | Analog Input 12         | 0-5V or +/-2.5V range (1)                                                                         |
| 14                                                                                                                                                                                                                                                                   | ANAI13 | Input    | Analog Input 13         | 0-5V or +/-2.5V range (1)                                                                         |
| 15                                                                                                                                                                                                                                                                   | ANAI14 | Input    | Analog Input 14         | 0-5V or +/-2.5V range (1)                                                                         |
| 16                                                                                                                                                                                                                                                                   | ANAI15 | Input    | Analog Input 15         | 0-5V or +/-2.5V range (1)                                                                         |
| 17                                                                                                                                                                                                                                                                   | GND    | Common   | PMAC Common             | Not isolated from digital                                                                         |
| 18                                                                                                                                                                                                                                                                   | +12V   | Output   | Positive Supply Voltage | To power external circuitry                                                                       |
| 19                                                                                                                                                                                                                                                                   | GND    | Common   | PMAC Common             | Not isolated from digital                                                                         |
| 20                                                                                                                                                                                                                                                                   | -12V   | Output   | Negative Supply Voltage | To power external circuitry                                                                       |
| The JANA connector provides the inputs for the 8 or 16 optional analog inputs on the PMAC2.<br><b>Note:</b> Connector J1 is present only if Option 12 is ordered. Analog inputs ANAI08 to ANAI15 are present only if Option 12A is ordered in addition to Option 12. |        |          |                         |                                                                                                   |

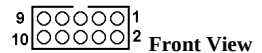
| J2/JTHW (26-Pin Header)                                                                                                                                                                                                                                                   |        |          |                 | <br>Front View |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------|-----------------|---------------------------------------------------------------------------------------------------|
| Pin #                                                                                                                                                                                                                                                                     | Symbol | Function | Description     | Notes                                                                                             |
| 1                                                                                                                                                                                                                                                                         | GND    | Common   | PMAC Common     |                                                                                                   |
| 2                                                                                                                                                                                                                                                                         | GND    | Common   | PMAC Common     |                                                                                                   |
| 3                                                                                                                                                                                                                                                                         | DAT0   | Input    | Data-0 Input    | Data Input from Mux Port Accessories                                                              |
| 4                                                                                                                                                                                                                                                                         | SEL0   | Output   | Select-0 Output | Address/Data Output for Mux Port Accessories                                                      |
| 5                                                                                                                                                                                                                                                                         | DAT1   | Input    | Data-1 Input    | Data Input from Mux Port Accessories                                                              |
| 6                                                                                                                                                                                                                                                                         | SEL1   | Output   | Select-1 Output | Address/Data Output for Mux Port Accessories                                                      |
| 7                                                                                                                                                                                                                                                                         | DAT2   | Input    | Data-2 Input    | Data Input from Mux Port Accessories                                                              |
| 8                                                                                                                                                                                                                                                                         | SEL2   | Output   | Select-2 Output | Address/Data Output for Mux Port Accessories                                                      |
| 9                                                                                                                                                                                                                                                                         | DAT3   | Input    | Data-3 Input    | Data Input from Mux Port Accessories                                                              |
| 10                                                                                                                                                                                                                                                                        | SEL3   | Output   | Select-3 Output | Address/Data Output for Mux Port Accessories                                                      |
| 11                                                                                                                                                                                                                                                                        | DAT4   | Input    | Data-4 Input    | Data Input from Mux Port Accessories                                                              |
| 12                                                                                                                                                                                                                                                                        | SEL4   | Output   | Select-4 Output | Address/Data Output for Mux Port Accessories                                                      |
| 13                                                                                                                                                                                                                                                                        | DAT5   | Input    | Data-5 Input    | Data Input from Mux Port Accessories                                                              |
| 14                                                                                                                                                                                                                                                                        | SEL5   | Output   | Select-5 Output | Address/Data Output for Mux Port Accessories                                                      |
| 15                                                                                                                                                                                                                                                                        | DAT6   | Input    | Data-6 Input    | Data Input from Mux Port Accessories                                                              |
| 16                                                                                                                                                                                                                                                                        | SEL6   | Output   | Select-6 Output | Address/Data Output for Mux Port Accessories                                                      |
| 17                                                                                                                                                                                                                                                                        | DAT7   | Input    | Data-7 Input    | Data Input from Mux Port Accessories                                                              |
| 18                                                                                                                                                                                                                                                                        | SEL7   | Output   | Select-7 Output | Address/Data Output for Mux Port Accessories                                                      |
| 19                                                                                                                                                                                                                                                                        | N.C.   | N.C.     | No Connection   |                                                                                                   |
| 20                                                                                                                                                                                                                                                                        | GND    | Common   | PMAC Common     |                                                                                                   |
| 21                                                                                                                                                                                                                                                                        | BRLD/  | Output   | Buffer Request  | Low Is Buffer Req.                                                                                |
| 22                                                                                                                                                                                                                                                                        | GND    | Common   | PMAC Common     |                                                                                                   |
| 23                                                                                                                                                                                                                                                                        | IPLD/  | Output   | In Position     | Low Is In Position                                                                                |
| 24                                                                                                                                                                                                                                                                        | GND    | Common   | PMAC Common     |                                                                                                   |
| 25                                                                                                                                                                                                                                                                        | +5V    | Output   | +5Vdc Supply    | Power Supply Out                                                                                  |
| 26                                                                                                                                                                                                                                                                        | INIT/  | Input    | PMAC Reset      | Low Is Reset                                                                                      |
| The JTHW connector provides eight inputs and eight outputs at TTL levels; typically these are used to create multiplexed I/O with accessory boards such as Acc-18 (Thumbwheel) and Acc-34 (Discrete I/O). The port I/O may also be used directly, as non-multiplexed I/O. |        |          |                 |                                                                                                   |

| J3/JIO (40-Pin Header) |        |          |                   |  |
|------------------------|--------|----------|-------------------|-------------------------------------------------------------------------------------|
| Pin #                  | Symbol | Function | Description       | Notes                                                                               |
| 1                      | I/O00  | In/Out   | Digital I/O 0     | Software direction ctrl.                                                            |
| 2                      | I/O01  | In/Out   | Digital I/O 1     | Software direction ctrl.                                                            |
| 3                      | I/O02  | In/Out   | Digital I/O 2     | Software direction ctrl.                                                            |
| 4                      | I/O03  | In/Out   | Digital I/O 3     | Software direction ctrl.                                                            |
| 5                      | I/O04  | In/Out   | Digital I/O 4     | Software direction ctrl.                                                            |
| 6                      | I/O05  | In/Out   | Digital I/O 5     | Software direction ctrl.                                                            |
| 7                      | I/O06  | In/Out   | Digital I/O 6     | Software direction ctrl.                                                            |
| 8                      | I/O07  | In/Out   | Digital I/O 7     | Software direction ctrl.                                                            |
| 9                      | I/O08  | In/Out   | Digital I/O 8     | Software direction ctrl.                                                            |
| 10                     | I/O09  | In/Out   | Digital I/O 9     | Software direction ctrl.                                                            |
| 11                     | I/O10  | In/Out   | Digital I/O 10    | Software direction ctrl.                                                            |
| 12                     | I/O11  | In/Out   | Digital I/O 11    | Software direction ctrl.                                                            |
| 13                     | I/O12  | In/Out   | Digital I/O 12    | Software direction ctrl.                                                            |
| 14                     | I/O13  | In/Out   | Digital I/O 13    | Software direction ctrl.                                                            |
| 15                     | I/O14  | In/Out   | Digital I/O 14    | Software direction ctrl.                                                            |
| 16                     | I/O15  | In/Out   | Digital I/O 15    | Software direction ctrl.                                                            |
| 17                     | I/O16  | In/Out   | Digital I/O 16    | Software direction ctrl.                                                            |
| 18                     | I/O17  | In/Out   | Digital I/O 17    | Software direction ctrl.                                                            |
| 19                     | I/O18  | In/Out   | Digital I/O 18    | Software direction ctrl.                                                            |
| 20                     | I/O19  | In/Out   | Digital I/O 19    | Software direction ctrl.                                                            |
| 21                     | I/O20  | In/Out   | Digital I/O 20    | Software direction ctrl.                                                            |
| 22                     | I/O21  | In/Out   | Digital I/O 21    | Software direction ctrl.                                                            |
| 23                     | I/O22  | In/Out   | Digital I/O 22    | Software direction ctrl.                                                            |
| 24                     | I/O23  | In/Out   | Digital I/O 23    | Software direction ctrl.                                                            |
| 25                     | I/O24  | In/Out   | Digital I/O 24    | Software direction ctrl.                                                            |
| 26                     | I/O25  | In/Out   | Digital I/O 25    | Software direction ctrl.                                                            |
| 27                     | I/O26  | In/Out   | Digital I/O 26    | Software direction ctrl.                                                            |
| 28                     | I/O27  | In/Out   | Digital I/O 27    | Software direction ctrl.                                                            |
| 29                     | I/O28  | In/Out   | Digital I/O 28    | Software direction ctrl.                                                            |
| 30                     | I/O29  | In/Out   | Digital I/O 29    | Software direction ctrl.                                                            |
| 31                     | I/O30  | In/Out   | Digital I/O 30    | Software direction ctrl.                                                            |
| 32                     | I/O31  | In/Out   | Digital I/O 31    | Software direction ctrl.                                                            |
| 33                     | GND    | Common   | Reference Voltage |                                                                                     |
| 34                     | GND    | Common   | Reference Voltage |                                                                                     |
| 35                     | PHASE/ | Output   | Phase Clock       | For latching data                                                                   |
| 36                     | SERVO/ | Output   | Servo Clock       | For latching data                                                                   |
| 37                     | GND    | Common   | Reference Voltage |                                                                                     |
| 38                     | GND    | Common   | Reference Voltage |                                                                                     |
| 39                     | +5V    | Output   | Supply Voltage    | To power external circuitry                                                         |
| 40                     | +5V    | Output   | Supply Voltage    | To power external circuitry                                                         |

The JI/O connector provides 32 input/output pins at TTL levels. Direction can be controlled in byte-wide groups.

| J4 (JMACRO) 26-Pin Header |         |          |                   |  |
|---------------------------|---------|----------|-------------------|-------------------------------------------------------------------------------------|
| Pin #                     | Symbol  | Function | Description       | Notes                                                                               |
| 1                         | DOUT7   | Output   | Ring Out Bit 7    | Macro Ring Command                                                                  |
| 2                         | DOUT6   | Output   | Ring Out Bit 6    | Macro Ring Transmit                                                                 |
| 3                         | DOUT5   | Output   | Ring Out Bit 5    | Macro Ring Transmit                                                                 |
| 4                         | DOUT4   | Output   | Ring Out Bit 4    | Macro Ring Transmit                                                                 |
| 5                         | DOUT3   | Output   | Ring Out Bit 3    | Macro Ring Transmit                                                                 |
| 6                         | DOUT2   | Output   | Ring Out Bit 2    | Macro Ring Transmit                                                                 |
| 7                         | DOUT1   | Output   | Ring Out Bit 1    | Macro Ring Transmit                                                                 |
| 8                         | DOUT0   | Output   | Ring Out Bit 0    | Macro Ring Transmit                                                                 |
| 9                         | CMD_IN  | Input    |                   |                                                                                     |
| 10                        | DIN7    | Input    | Ring In Bit 7     | Macro Ring Receive                                                                  |
| 11                        | DIN6    | Input    | Ring In Bit 6     | Macro Ring Receive                                                                  |
| 12                        | DIN5    | Input    | Ring In Bit 5     | Macro Ring Receive                                                                  |
| 13                        | DIN4    | Input    | Ring In Bit 4     | Macro Ring Receive                                                                  |
| 14                        | DIN3    | Input    | Ring In Bit 3     | Macro Ring Receive                                                                  |
| 15                        | DIN2    | Input    | Ring In Bit 2     | Macro Ring Receive                                                                  |
| 16                        | DIN1    | Input    | Ring In Bit 1     | Macro Ring Receive                                                                  |
| 17                        | DIN0    | Input    | Ring In Bit 0     | Macro Ring Receive                                                                  |
| 18                        | CMD_OUT | Output   |                   |                                                                                     |
| 19                        | TCLK    | Output   | Ring Clock        | 10 MHz                                                                              |
| 20                        | GND     | Common   | Reference Voltage |                                                                                     |
| 21                        | STB_OUT | Output   | Byte Strobe       |                                                                                     |
| 22                        | GND     | Common   | Reference Voltage |                                                                                     |
| 23                        | DAT_STB | Input    | Data Byte Strobe  |                                                                                     |
| 24                        | GND     | Common   | Reference Voltage |                                                                                     |
| 25                        | CMD_STB | Input    | Cmd Byte Strobe   |                                                                                     |
| 26                        | VLTN    | Input    | Violation Flag    | Taxi Chip Receive Error                                                             |

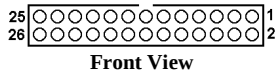
The JMACRO Network Ring Interface Connector provides the interface to the Acc-42 MACRO driver/receiver accessory board.

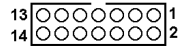
| J5/JRS232 (10-Pin Header) |        |          |                |  |
|---------------------------|--------|----------|----------------|---------------------------------------------------------------------------------------|
| Pin #                     | Symbol | Function | Description    | Notes                                                                                 |
| 1                         | PHASE  | In/Out   | Phasing Clock  | See Notes 1, 2                                                                        |
| 2                         | DTR    | Bidirect | Data Term Rdy  | Tied to DSR                                                                           |
| 3                         | TXD/   | Input    | Receive Data   | Host transmit data                                                                    |
| 4                         | CTS    | Input    | Clear To Send  | Host ready bit                                                                        |
| 5                         | RXD/   | Output   | Send Data      | Host receive data                                                                     |
| 6                         | RTS    | Output   | Req. To Send   | PMAC ready bit                                                                        |
| 7                         | DSR    | Bidirect | Data Set Ready | Tied to DTR                                                                           |
| 8                         | SERVO  | In/Out   | Servo Clock    | See Note 2                                                                            |
| 9                         | GND    | Common   | Pmac Common    |                                                                                       |
| 10                        | +5V    | Output   | +5vdc Supply   | Power Supply Out                                                                      |

This connector is used for serial communications on a PMAC2 VME if E17 and E18 jumpers connect pins 1 and 2. This connector cannot be used for daisy chain communication interconnection of multiple PMACs, although it can be used to share servo and phase clocks for synchronicity. The J5A RS-422 interface is required for daisy chain communication.

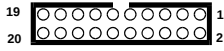
**Note 1:** If communicating to PMAC2 over this connector with a modem style terminal emulator such as Microsoft Windows Terminal, line 1 should not be connected.

**Note 2:** SERVO and PHASE are outputs if jumper E1 is OFF; they are inputs if jumper E1 is ON.

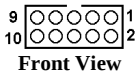
| J5A/JRS422 (26-Pin Header)                                                                                                                                                                                                                                                                                                                   |        |          |                |  |
|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------|----------------|-------------------------------------------------------------------------------------|
| Pin #                                                                                                                                                                                                                                                                                                                                        | Symbol | Function | Description    | Notes                                                                               |
| 1                                                                                                                                                                                                                                                                                                                                            | CHASSI | Common   | PMAC Common    |                                                                                     |
| 2                                                                                                                                                                                                                                                                                                                                            | S+5V   | Output   | +5Vdc Supply   |                                                                                     |
| 3                                                                                                                                                                                                                                                                                                                                            | RD-    | Input    | Receive Data   | Diff. I/O Low True **                                                               |
| 4                                                                                                                                                                                                                                                                                                                                            | RD+    | Input    | Receive Data   | Diff. I/O High True *                                                               |
| 5                                                                                                                                                                                                                                                                                                                                            | SD-    | Output   | Send Data      | Diff. I/O Low True **                                                               |
| 6                                                                                                                                                                                                                                                                                                                                            | SD+    | Output   | Send Data      | Diff. I/O High True *                                                               |
| 7                                                                                                                                                                                                                                                                                                                                            | CS+    | Input    | Clear to Send  | Diff. I/O High True **                                                              |
| 8                                                                                                                                                                                                                                                                                                                                            | CS-    | Input    | Clear to Send  | Diff. I/O Low True *                                                                |
| 9                                                                                                                                                                                                                                                                                                                                            | RS+    | Output   | Req. to Send   | Diff. I/O High True **                                                              |
| 10                                                                                                                                                                                                                                                                                                                                           | RS-    | Output   | Req. to Send   | Diff. I/O Low True *                                                                |
| 11                                                                                                                                                                                                                                                                                                                                           | DTR    | Bidirect | Data Term Read | Tied to DSR                                                                         |
| 12                                                                                                                                                                                                                                                                                                                                           | INIT/  | Input    | PMAC Reset     | Low is Reset                                                                        |
| 13                                                                                                                                                                                                                                                                                                                                           | GND    | Common   | PMAC Common    | **                                                                                  |
| 14                                                                                                                                                                                                                                                                                                                                           | DSR    | Bidirect | Data Set Ready | Tied to DTR                                                                         |
| 15                                                                                                                                                                                                                                                                                                                                           | SDIO-  | Bidirect | Special Data   | Diff. I/O Low True                                                                  |
| 16                                                                                                                                                                                                                                                                                                                                           | SDIO+  | Bidirect | Special Data   | Diff. I/O High True                                                                 |
| 17                                                                                                                                                                                                                                                                                                                                           | SCIO-  | Bidirect | Special Ctrl.  | Diff. I/O Low True                                                                  |
| 18                                                                                                                                                                                                                                                                                                                                           | SCIO+  | Bidirect | Special Ctrl.  | Diff. I/O High True                                                                 |
| 19                                                                                                                                                                                                                                                                                                                                           | SCK-   | Bidirect | Special Clock  | Diff. I/O Low True                                                                  |
| 20                                                                                                                                                                                                                                                                                                                                           | SCK+   | Bidirect | Special Clock  | Diff. I/O High True                                                                 |
| 21                                                                                                                                                                                                                                                                                                                                           | SERVO- | Bidirect | Servo Clock    | Diff. I/O Low True ***                                                              |
| 22                                                                                                                                                                                                                                                                                                                                           | SERVO+ | Bidirect | Servo Clock    | Diff. I/O High True ***                                                             |
| 23                                                                                                                                                                                                                                                                                                                                           | PHASE- | Bidirect | Phase Clock    | Diff. I/O Low True ***                                                              |
| 24                                                                                                                                                                                                                                                                                                                                           | PHASE+ | Bidirect | Phase Clock    | Diff. I/O High True ***                                                             |
| 25                                                                                                                                                                                                                                                                                                                                           | GND    | Common   | PMAC Common    |                                                                                     |
| 26                                                                                                                                                                                                                                                                                                                                           | +5V    | Output   | +5vdc Supply   | Power supply out                                                                    |
| This connector can be used for serial communications on a PMAC2 VME if E17 and E18 jumpers connect pins 2 and 3. If these jumpers connect pins 1 and 2, the J5 RS-232 connector should be used instead for serial communications. In addition, this connector is used to daisy chain interconnect multiple PMACs for synchronized operation. |        |          |                |                                                                                     |
| <b>Note:</b> Jumpers E17 and E18 must connect pins 2 and 3 to use this port for serial communications.                                                                                                                                                                                                                                       |        |          |                |                                                                                     |

| <b>J6/JDISP (14-Pin Header)</b> |        |          |                     | <br>Front View |
|---------------------------------|--------|----------|---------------------|---------------------------------------------------------------------------------------------------|
| Pin #                           | Symbol | Function | Description         | Notes                                                                                             |
| 1                               | VDD    | Output   | +5V Power           | Power Supply Out                                                                                  |
| 2                               | VSS    | Common   | PMAC Common         |                                                                                                   |
| 3                               | RS     | Output   | Read Strobe         | TTL Signal Out                                                                                    |
| 4                               | VEE    | Output   | Contrast Adjust VEE | 0 to +5Vdc *                                                                                      |
| 5                               | E      | Output   | Display Enable      | High is Enable                                                                                    |
| 6                               | R/W    | Output   | Read Or Write       | TTL Signal Out                                                                                    |
| 7                               | DB1    | Output   | Display Data1       |                                                                                                   |
| 8                               | DB0    | Output   | Display Data0       |                                                                                                   |
| 9                               | DB3    | Output   | Display Data3       |                                                                                                   |
| 10                              | DB2    | Output   | Display Data2       |                                                                                                   |
| 11                              | DB5    | Output   | Display Data5       |                                                                                                   |
| 12                              | DB4    | Output   | Display Data4       |                                                                                                   |
| 13                              | DB7    | Output   | Display Data7       |                                                                                                   |
| 14                              | DB6    | Output   | Display Data6       |                                                                                                   |

The JDISP connector is used to drive the 2-line x 24-character (acc-12), 2 x 40 (acc-12a) LCD, or the 2 x 40 vacuum fluorescent (acc 12c) display unit. The display command may be used to send messages and values to the display.

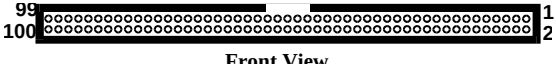
| <b>J7/JHW (20-Pin Header)</b> |        |          |                  | <br>Front View |
|-------------------------------|--------|----------|------------------|---------------------------------------------------------------------------------------------------|
| Pin #                         | Symbol | Function | Description      | Notes                                                                                             |
| 1                             | GND    | Common   | Ref. Voltage     |                                                                                                   |
| 2                             | +5V    | Output   | Supply Voltage   | To power external circuitry                                                                       |
| 3                             | HWA1+  | Input    | Hw Pos A Chan.   | Also pulse input                                                                                  |
| 4                             | HWA1-  | Input    | Hw Neg A Chan.   | Also pulse input                                                                                  |
| 5                             | HWB1+  | Input    | Hw Pos B Chan.   | Also direction input                                                                              |
| 6                             | HWB1-  | Input    | Hw Neg B Chan.   | Also direction input                                                                              |
| 7                             | HWA2+  | Input    | Hw Pos A Chan.   | Also pulse input                                                                                  |
| 8                             | HWA2-  | Input    | Hw Neg A Chan.   | Also pulse input                                                                                  |
| 9                             | HWB2+  | Input    | Hw Pos B Chan.   | Also direction input                                                                              |
| 10                            | HWB2-  | Input    | Hw Neg B Chan.   | Also direction input                                                                              |
| 11                            | PUL1+  | Output   | Pfm Pos Pulse    | Also PWM output                                                                                   |
| 12                            | PUL1-  | Output   | Pfm Neg Pulse    | Also PWM output                                                                                   |
| 13                            | DIR1+  | Output   | Pfm Pos Dir. Out | Also PWM output                                                                                   |
| 14                            | DIR1-  | Output   | Pfm Neg Dir Out  | Also PWM output                                                                                   |
| 15                            | PUL2+  | Output   | Pfm Pos Pulse    | Also PWM output                                                                                   |
| 16                            | PUL2-  | Output   | Pfm Neg Pulse    | Also PWM output                                                                                   |
| 17                            | DIR2+  | Output   | Pfm Pos Dir. Out | Also PWM output                                                                                   |
| 18                            | DIR2-  | Output   | Pfm Neg Dir Out  | Also PWM output                                                                                   |
| 19                            | GND    | Common   | Ref. Voltage     |                                                                                                   |
| 20                            | +5V    | Output   | Supply Voltage   | To power external circuitry                                                                       |

Typically, this connector provides the interface for two quadrature encoders to be used as handwheel or time-base master encoders.

| J8/JEQU (10-Pin Header) |        |          |                 | <br>Front View |
|-------------------------|--------|----------|-----------------|---------------------------------------------------------------------------------------------------|
| Pin #                   | Symbol | Function | Description     | Notes                                                                                             |
| 1                       | EQU1/  | Output   | Enc. 1 Comp-Eq  | Low is true                                                                                       |
| 2                       | EQU2/  | Output   | Enc. 2 Comp-Eq  | Low is true                                                                                       |
| 3                       | EQU3/  | Output   | Enc. 3 Comp-Eq  | Low is true                                                                                       |
| 4                       | EQU4/  | Output   | Enc. 4 Comp-Eq  | Low is true                                                                                       |
| 5                       | EQU5/  | Output   | Enc. 5 Comp-Eq  | Low is true                                                                                       |
| 6                       | EQU6/  | Output   | Enc. 6 Comp-Eq  | Low is true                                                                                       |
| 7                       | EQU7/  | Output   | Enc. 7 Comp-Eq  | Low is true                                                                                       |
| 8                       | EQU8/  | Output   | Enc. 8 Comp-Eq  | Low is true                                                                                       |
| 9                       | +V     | Supply   | Positive Supply | +5V to +24V                                                                                       |
| 10                      | GND    | Common   | Digital Ground  |                                                                                                   |

This connector provides the position-compare outputs for the eight encoder channels.

| J9/JMACH1 (100-Pin Header) |           |                |                           | <br>Front View |
|----------------------------|-----------|----------------|---------------------------|--------------------------------------------------------------------------------------------------|
| Pin#                       | Symbol    | Function       | Description               | Notes                                                                                            |
| 1                          | +5V       | Output / Input | +5V Power                 | For external circuit or from external supply                                                     |
| 2                          | +5V       | Output / Input | +5V Power                 |                                                                                                  |
| 3                          | GND       | Common         | Reference Voltage         |                                                                                                  |
| 4                          | GND       | Common         | Reference Voltage         |                                                                                                  |
| 5                          | CHA1+     | Input          | Enc 1 Pos. A Chan.        | Also pulse input                                                                                 |
| 6                          | CHA1-     | Input          | Enc 1 Neg. A Chan.        |                                                                                                  |
| 7                          | CHB1+     | Input          | Enc 1 Pos. B Chan.        | Also direction input                                                                             |
| 8                          | CHB1-     | Input          | Enc 1 Neg. B Chan.        |                                                                                                  |
| 9                          | CHC1+     | Input          | Enc 1 Pos. C Chan.        | Index channel                                                                                    |
| 10                         | CHC1-     | Input          | Enc 1 Neg. C Chan.        |                                                                                                  |
| 11                         | CHU1      | Input          | Chan 1 U Flag             | Hall effect, fault code, or sub-count                                                            |
| 12                         | CHV1      | Input          | Chan 1 V Flag             | Hall effect, fault code, or sub-count                                                            |
| 13                         | CHW1      | Input          | Chan 1 W Flag             | Hall effect, fault code, or sub-count                                                            |
| 14                         | CHT1      | Input          | Chan 1 T Flag             | Fault code, or sub-count                                                                         |
| 15                         | USER1     | Input          | General Purpose User Flag | Hardware capture flag, or sub-count                                                              |
| 16                         | PLIM1     | Input          | Positive Overtravel Limit | Hardware capture flag                                                                            |
| 17                         | MLIM1     | Input          | Negative Overtravel Limit | Hardware capture flag                                                                            |
| 18                         | HOME1     | Input          | Home Switch Input         | Hardware capture flag                                                                            |
| 19                         | ACCFLT1   | Input          | Accessory Fault Flag      | For loss of ACC supply voltage                                                                   |
| 20                         | WD0/      | Output         | Watchdog Output           | Low is PMAC watchdog fault                                                                       |
| 21                         | SCLK12+   | Input/Output   | Encoder Sample Clock      | Direction controlled by PMAC2 jumper                                                             |
| 22                         | SCLK12-   | Input/Output   | Encoder Sample Clock      |                                                                                                  |
| 23                         | ADC_CLK1+ | Output         | A/D Converter Clock       | Programmable frequency                                                                           |
| 24                         | ADC_CLK1- | Output         | A/D Converter Clock       |                                                                                                  |
| 25                         | ADC_STB1+ | Output         | A/D Converter Strobe      | Programmable sequence                                                                            |
| 26                         | ADC_STB1- | Output         | A/D Converter Strobe      |                                                                                                  |
| 27                         | ADC_DAA1+ | Input          | Chan A Adc Serial Data    | MSB first                                                                                        |
| 28                         | ADC_DAA1- | Input          | Chan A Adc Serial Data    |                                                                                                  |
| 29                         | ADC_DAB1+ | Input          | Chan B Adc Serial Data    | MSB first                                                                                        |
| 30                         | ADC_DAB1- | Input          | Chan B Adc Serial Data    |                                                                                                  |
| 31                         | AENA1+    | Output         | Amplifier Enable          | High is enable                                                                                   |
| 32                         | AENA1-    | Output         | Amplifier Enable          | Low is enable                                                                                    |

| J9/JMACH1 (100-Pin Header) |                        |                |                                         | <div>  </div> |
|----------------------------|------------------------|----------------|-----------------------------------------|-------------------------------------------------------------------------------------------------|
| Pin#                       | Symbol                 | Function       | Description                             | Notes                                                                                           |
| 33                         | FAULT1+                | Input          | Amplifier Fault                         | Programmable polarity                                                                           |
| 34                         | FAULT1-                | Input          | Amplifier Fault                         |                                                                                                 |
| 35                         | PWMATOP1+<br>DAC_CLK1+ | Output         | Phase A Top CMD or DAC Clock            | Programmable function control                                                                   |
| 36                         | PWMATOP1-<br>DAC_CLK1- | Output         | Phase A Top CMD or DAC Clock            |                                                                                                 |
| 37                         | PWMABOT1+<br>DAC1A+    | Output         | Phase A Bottom CMD or DAC A Serial Data | Programmable function control                                                                   |
| 38                         | PWMABOT1-<br>DAC1A-    | Output         | Phase A Bottom CMD or DAC A Serial Data |                                                                                                 |
| 39                         | PWMBTOP1+<br>DAC_STB1+ | Output         | Phase B Top CMD or DAC Strobe           | Programmable function control                                                                   |
| 40                         | PWMBTOP1-<br>DAC_STB1- | Output         | Phase B Top CMD or DAC Strobe           |                                                                                                 |
| 41                         | PWMBBOT1+<br>DAC1B+    | Output         | Phase B Bottom CMD or DAC B Serial Data | Programmable function control                                                                   |
| 42                         | PWMBBOT1-<br>DAC1B-    | Output         | Phase B Bottom CMD or DAC B Serial Data |                                                                                                 |
| 43                         | PWMCTOP1+<br>DIR1+     | Output         | Phase B Top CMD or PFM Direction        | Programmable function control                                                                   |
| 44                         | PWMCTOP1-<br>DIR1-     | Output         | Phase B Top CMD or PFM Direction        |                                                                                                 |
| 45                         | PWMCBOT1+<br>PULSE1+   | Output         | Phase B Bottom CMD or PFM Pulse         | Programmable function control                                                                   |
| 46                         | PWMCBOT1-<br>PULSE1-   | Output         | Phase B Bottom CMD or PFM Pulse         |                                                                                                 |
| 47                         | GND                    | Common         | Reference Voltage                       |                                                                                                 |
| 48                         | GND                    | Common         | Reference Voltage                       |                                                                                                 |
| 49                         | +5V                    | Output / Input | +5V Power                               | For external circuit or from external supply                                                    |
| 50                         | +5V                    | Output / Input | +5V Power                               |                                                                                                 |
| 51                         | +5V                    | Output / Input | +5V Power                               | For external circuit or from external supply                                                    |
| 52                         | +5V                    | Output / Input | +5V Power                               |                                                                                                 |
| 53                         | GND                    | Common         | Reference Voltage                       |                                                                                                 |
| 54                         | GND                    | Common         | Reference Voltage                       |                                                                                                 |
| 55                         | CHA2+                  | Input          | Enc 2 Pos. A Chan.                      | Also pulse input                                                                                |
| 56                         | CHA2-                  | Input          | Enc 2 Neg. A Chan.                      |                                                                                                 |
| 57                         | CHB2+                  | Input          | Enc 2 Pos. B Chan.                      | Also direction input                                                                            |
| 58                         | CHB2-                  | Input          | Enc 2 Neg. B Chan.                      |                                                                                                 |
| 59                         | CHC2+                  | Input          | Enc 2 Pos. C Chan.                      | Index channel                                                                                   |
| 60                         | CHC2-                  | Input          | Enc 2 Neg. C Chan.                      |                                                                                                 |
| 61                         | CHU2                   | Input          | Chan 2 U Flag                           | Hall effect, fault code, or sub-count                                                           |
| 62                         | CHV2                   | Input          | Chan 2 V Flag                           | Hall effect, fault code, or sub-count                                                           |
| 63                         | CHW2                   | Input          | Chan 2 W Flag                           | Hall effect, fault code, or sub-count                                                           |
| 64                         | CHT2                   | Input          | Chan 2 T Flag                           | Fault code, or sub-count                                                                        |
| 65                         | USER2                  | Input          | General Purpose User Flag               | Hardware capture flag, or sub-count                                                             |
| 66                         | PLIM2                  | Input          | Positive Overtravel Limit               | Hardware capture flag                                                                           |
| 67                         | MLIM2                  | Input          | Negative Overtravel Limit               | Hardware capture flag                                                                           |
| 68                         | HOME2                  | Input          | Home Switch Input                       | Hardware capture flag                                                                           |

| J9/JMACH1 (100-Pin Header) |                        |                |                                         | <div>  </div> |
|----------------------------|------------------------|----------------|-----------------------------------------|-------------------------------------------------------------------------------------------------|
| Pin#                       | Symbol                 | Function       | Description                             | Notes                                                                                           |
| 69                         | ACCFLT2                | Input          | Accessory Fault Flag                    | For loss of ACC supply voltage                                                                  |
| 70                         | WD0/                   | Output         | Watchdog Output                         | Low is PMAC watchdog fault                                                                      |
| 71                         | SCLK12+                | Input / Output | Encoder Sample Clock                    | Direction controlled by PMAC2 jumper                                                            |
| 72                         | SCLK12-                | Input / Output | Encoder Sample Clock                    |                                                                                                 |
| 73                         | ADC_CLK2+              | Output         | A/D Converter Clock                     | Programmable Frequency                                                                          |
| 74                         | ADC_CLK2-              | Output         | A/D Converter Clock                     |                                                                                                 |
| 75                         | ADC_STB2+              | Output         | A/D Converter Strobe                    | Programmable sequence                                                                           |
| 76                         | ADC_STB2-              | Output         | A/D Converter Strobe                    |                                                                                                 |
| 77                         | ADC_DAA2+              | Input          | Chan A Adc Serial Data                  | MSB First                                                                                       |
| 78                         | ADC_DAA2-              | Input          | Chan A Adc Serial Data                  |                                                                                                 |
| 79                         | ADC_DAB2+              | Input          | Chan B Adc Serial Data                  | MSB First                                                                                       |
| 80                         | ADC_DAB2-              | Input          | Chan B Adc Serial Data                  |                                                                                                 |
| 81                         | AENA2+                 | Output         | Amplifier Enable                        | High Is Enable                                                                                  |
| 82                         | AENA2-                 | Output         | Amplifier Enable                        | Low Is Enable                                                                                   |
| 83                         | FAULT2+                | Input          | Amplifier Fault                         | Programmable polarity                                                                           |
| 84                         | FAULT2-                | Input          | Amplifier Fault                         |                                                                                                 |
| 85                         | PWMATOP2+<br>DAC_CLK2+ | Output         | Phase A Top CMD or DAC Clock            | Programmable function control                                                                   |
| 86                         | PWMATOP2-<br>DAC_CLK2- | Output         | Phase A Top CMD or DAC Clock            |                                                                                                 |
| 87                         | PWMABOT2+<br>DAC2A+    | Output         | Phase A Bottom CMD or DAC A Serial Data | Programmable function control                                                                   |
| 88                         | PWMABOT2-<br>DAC2A-    | Output         | Phase A Bottom CMD or DAC A Serial Data |                                                                                                 |
| 89                         | PWMBTOP2+<br>DAC_STB2+ | Output         | Phase B Top CMD or DAC Strobe           | Programmable function control                                                                   |
| 90                         | PWMBTOP2-<br>DAC_STB2- | Output         | Phase B Top CMD or DAC Strobe           |                                                                                                 |
| 91                         | PWMBBOT2+<br>DAC2B+    | Output         | Phase B Bottom CMD or DAC B Serial Data | Programmable function control                                                                   |
| 92                         | PWMBBOT2-<br>DAC2B-    | Output         | Phase B Bottom CMD or DAC B Serial Data |                                                                                                 |
| 93                         | PWMCTOP2+<br>DIR2+     | Output         | Phase B Top CMD or PFM Direction        | Programmable function control                                                                   |
| 94                         | PWMCTOP2-<br>DIR2-     | Output         | Phase B Top CMD or PFM Direction        |                                                                                                 |
| 95                         | PWMCBOT2+<br>PULSE2+   | Output         | Phase B Bottom CMD or PFM Pulse         | Programmable function control                                                                   |
| 96                         | PWMCBOT2-<br>PULSE2-   | Output         | Phase B Bottom CMD or PFM Pulse         |                                                                                                 |
| 97                         | GND                    | Common         | Reference Voltage                       |                                                                                                 |
| 98                         | GND                    | Common         | Reference Voltage                       |                                                                                                 |
| 99                         | +5V                    | Output / Input | +5V Power                               | For external circuit or from external supply                                                    |
| 100                        | +5V                    | Output / Input | +5V Power                               |                                                                                                 |

The JMACH1 connector provides the interface pins for channels 1 and 2. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards or an application-specific interface board.

**Note:** 100-pin male box header with center key, 0050 pitch. AMP part # 1-04068-7. Delta Tau part # 014-00010-FPB.

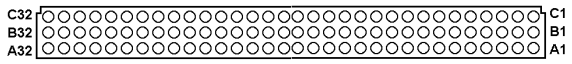
| J10/JMACH2 (100-Pin Header) |                        |                |                                         |  |
|-----------------------------|------------------------|----------------|-----------------------------------------|------------------------------------------------------------------------------------|
|                             |                        |                |                                         | Front View                                                                         |
| Pin#                        | Symbol                 | Function       | Description                             | Notes                                                                              |
| 1                           | +5V                    | Output / Input | +5V Power                               | For external circuit or from ext. Supply                                           |
| 2                           | +5V                    | Output / Input | +5V Power                               |                                                                                    |
| 3                           | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 4                           | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 5                           | CHA3+                  | Input          | Enc 3 Pos. A Chan.                      | Also pulse input                                                                   |
| 6                           | CHA3-                  | Input          | Enc 3 Neg. A Chan.                      |                                                                                    |
| 7                           | CHB3+                  | Input          | Enc 3 Pos. B Chan.                      | Also direction input                                                               |
| 8                           | CHB3-                  | Input          | Enc 3 Neg. B Chan.                      |                                                                                    |
| 9                           | CHC3+                  | Input          | Enc 3 Pos. C Chan.                      | Index channel                                                                      |
| 10                          | CHC3-                  | Input          | Enc 3 Neg. C Chan.                      |                                                                                    |
| 11                          | CHU3                   | Input          | Chan 3 U Flag                           | Hall effect, fault code, or sub-count                                              |
| 12                          | CHV3                   | Input          | Chan 3 V Flag                           | Hall effect, fault code, or sub-count                                              |
| 13                          | CHW3                   | Input          | Chan 3 W Flag                           | Hall effect, fault code, or sub-count                                              |
| 14                          | CHT3                   | Input          | Chan 3 T Flag                           | Fault code, or sub-count                                                           |
| 15                          | USER3                  | Input          | General Purpose User Flag               | Hardware capture flag, or sub-count                                                |
| 16                          | PLIM3                  | Input          | Positive Overtravel Limit               | Hardware capture flag                                                              |
| 17                          | MLIM3                  | Input          | Negative Overtravel Limit               | Hardware capture flag                                                              |
| 18                          | HOME3                  | Input          | Home Switch Input                       | Hardware capture flag                                                              |
| 19                          | ACCFLT3                | Input          | Accessory Fault Flag                    | For loss of ACC supply voltage                                                     |
| 20                          | WD0/                   | Output         | Watchdog Output                         | Low is PMAC watchdog fault                                                         |
| 21                          | SCLK34+                | Input / Output | Encoder Sample Clock                    | Direction controlled by PMAC2 jumper                                               |
| 22                          | SCLK34-                | Input / Output | Encoder Sample Clock                    |                                                                                    |
| 23                          | ADC_CLK3+              | Output         | A/D Converter Clock                     | Programmable frequency                                                             |
| 24                          | ADC_CLK3-              | Output         | A/D Converter Clock                     |                                                                                    |
| 25                          | ADC_STB3+              | Output         | A/D Converter Strobe                    | Programmable sequence                                                              |
| 26                          | ADC_STB3-              | Output         | A/D Converter Strobe                    |                                                                                    |
| 27                          | ADC_DAA3+              | Input          | Chan A Adc Serial Data                  | MSB first                                                                          |
| 28                          | ADC_DAA3-              | Input          | Chan A Adc Serial Data                  |                                                                                    |
| 29                          | ADC_DAB3+              | Input          | Chan B Adc Serial Data                  | MSB first                                                                          |
| 30                          | ADC_DAB3-              | Input          | Chan B Adc Serial Data                  |                                                                                    |
| 31                          | AENA3+                 | Output         | Amplifier Enable                        | High is enable                                                                     |
| 32                          | AENA3-                 | Output         | Amplifier Enable                        | Low is enable                                                                      |
| 33                          | FAULT3+                | Input          | Amplifier Fault                         | Programmable polarity                                                              |
| 34                          | FAULT3-                | Input          | Amplifier Fault                         |                                                                                    |
| 35                          | PWMATOP3+<br>DAC_CLK3+ | Output         | Phase A Top CMD or DAC Clock            | Programmable Function Control                                                      |
| 36                          | PWMATOP3-<br>DAC_CLK3- | Output         | Phase A Top CMD or DAC Clock            |                                                                                    |
| 37                          | PWMABOT3+<br>DAC3A+    | Output         | Phase A Bottom CMD or DAC A Serial Data | Programmable function control                                                      |
| 38                          | PWMABOT3-<br>DAC3A-    | Output         | Phase A Bottom CMD or DAC A Serial Data |                                                                                    |
| 39                          | PWMBTOP3+<br>DAC_STB3+ | Output         | Phase B Top CMD or DAC Strobe           | Programmable function control                                                      |

| <b>J10/JMACH2 (100-Pin Header)</b> |                    |                |                                         |  |
|------------------------------------|--------------------|----------------|-----------------------------------------|------------------------------------------------------------------------------------|
|                                    |                    |                |                                         | Front View                                                                         |
| Pin#                               | Symbol             | Function       | Description                             | Notes                                                                              |
| 40                                 | PWMBTOP3-DAC_STB3- | Output         | Phase B Top CMD or DAC Strobe           |                                                                                    |
| 41                                 | PWMBBOT3+DAC3B+    | Output         | Phase B Bottom CMD or DAC B Serial Data | Programmable function control                                                      |
| 42                                 | PWMBBOT3-DAC3B-    | Output         | Phase B Bottom CMD or DAC B Serial Data |                                                                                    |
| 43                                 | PWMCTOP3+DIR3+     | Output         | Phase B Top CMD or PFM Direction        | Programmable function control                                                      |
| 44                                 | PWMCTOP3-DIR3-     | Output         | Phase B Top CMD or PFM Direction        |                                                                                    |
| 45                                 | PWMCBOT3+PULSE3+   | Output         | Phase B Bottom CMD or PFM Pulse         | Programmable function control                                                      |
| 46                                 | PWMCBOT3-PULSE3-   | Output         | Phase B Bottom CMD or PFM Pulse         |                                                                                    |
| 47                                 | GND                | Common         | Reference Voltage                       |                                                                                    |
| 48                                 | GND                | Common         | Reference Voltage                       |                                                                                    |
| 49                                 | +5V                | Output / Input | +5V Power                               | For external circuit or from external supply                                       |
| 50                                 | +5V                | Output / Input | +5V Power                               |                                                                                    |
| 51                                 | +5V                | Output / Input | +5V Power                               | For external circuit or from external supply                                       |
| 52                                 | +5V                | Output / Input | +5V Power                               |                                                                                    |
| 53                                 | GND                | Common         | Reference Voltage                       |                                                                                    |
| 54                                 | GND                | Common         | Reference Voltage                       |                                                                                    |
| 55                                 | CHA4+              | Input          | Enc 4 Pos. A Chan.                      | Also pulse input                                                                   |
| 56                                 | CHA4-              | Input          | Enc 4 Neg. A Chan.                      |                                                                                    |
| 57                                 | CHB4+              | Input          | Enc 4 Pos. B Chan.                      | Also direction input                                                               |
| 58                                 | CHB4-              | Input          | Enc 4 Neg. B Chan.                      |                                                                                    |
| 59                                 | CHC4+              | Input          | Enc 4 Pos. C Chan.                      | Index channel                                                                      |
| 60                                 | CHC4-              | Input          | Enc 4 Neg. C Chan.                      |                                                                                    |
| 61                                 | CHU4               | Input          | Chan 4 U Flag                           | Hall effect, fault code, or sub-count                                              |
| 62                                 | CHV4               | Input          | Chan 4 V Flag                           | Hall effect, fault code, or sub-count                                              |
| 63                                 | CHW4               | Input          | Chan 4 W Flag                           | Hall effect, fault code, or sub-count                                              |
| 64                                 | CHT4               | Input          | Chan 4 T Flag                           | Fault code, or sub-count                                                           |
| 65                                 | USER4              | Input          | General Purpose User Flag               | Hardware capture flag, or sub-count                                                |
| 66                                 | PLIM4              | Input          | Positive Overtravel Limit               | Hardware capture flag                                                              |
| 67                                 | MLIM4              | Input          | Negative Overtravel Limit               | Hardware capture flag                                                              |
| 68                                 | HOME4              | Input          | Home Switch Input                       | Hardware capture flag                                                              |
| 69                                 | ACCFLT4            | Input          | Accessory Fault Flag                    | For loss of ACC supply voltage                                                     |
| 70                                 | WD0/               | Output         | Watchdog Output                         | Low is PMAC watchdog fault                                                         |
| 71                                 | SCLK34+            | Input / Output | Encoder Sample Clock                    | Direction controlled by PMAC2 jumper                                               |
| 72                                 | SCLK34-            | Input / Output | Encoder Sample Clock                    |                                                                                    |
| 73                                 | ADC_CLK4+          | Output         | A/D Converter Clock                     | Programmable frequency                                                             |
| 74                                 | ADC_CLK4-          | Output         | A/D Converter Clock                     |                                                                                    |
| 75                                 | ADC_STB4+          | Output         | A/D Converter Strobe                    | Programmable sequence                                                              |

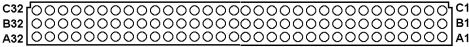
| J10/JMACH2 (100-Pin Header) |                        |                |                                         |  |
|-----------------------------|------------------------|----------------|-----------------------------------------|------------------------------------------------------------------------------------|
| Pin#                        | Symbol                 | Function       | Description                             | Notes                                                                              |
| 76                          | ADC_STB4-              | Output         | A/D Converter Strobe                    |                                                                                    |
| 77                          | ADC_DAA4+              | Input          | Chan A Adc Serial Data                  | MSB first                                                                          |
| 78                          | ADC_DAA4-              | Input          | Chan A Adc Serial Data                  |                                                                                    |
| 79                          | ADC_DAB4+              | Input          | Chan B Adc Serial Data                  | MSB first                                                                          |
| 80                          | ADC_DAB4-              | Input          | Chan B Adc Serial Data                  |                                                                                    |
| 81                          | AENA4+                 | Output         | Amplifier Enable                        | High is enable                                                                     |
| 82                          | AENA4-                 | Output         | Amplifier Enable                        | Low is enable                                                                      |
| 83                          | FAULT4+                | Input          | Amplifier Fault                         | Programmable polarity                                                              |
| 84                          | FAULT4-                | Input          | Amplifier Fault                         |                                                                                    |
| 85                          | PWMATOP4+<br>DAC_CLK4+ | Output         | Phase A Top CMD or DAC Clock            | Programmable function control                                                      |
| 86                          | PWMATOP4-<br>DAC_CLK4- | Output         | Phase A Top CMD or DAC Clock            |                                                                                    |
| 87                          | PWMABOT4+<br>DAC4A+    | Output         | Phase A Bottom CMD or DAC A Serial Data | Programmable function control                                                      |
| 88                          | PWMABOT4-<br>DAC4A-    | Output         | Phase A Bottom CMD or DAC A Serial Data |                                                                                    |
| 89                          | PWMBTOP4+<br>DAC_STB4+ | Output         | Phase B Top CMD or DAC Strobe           | Programmable function control                                                      |
| 90                          | PWMBTOP4-<br>DAC_STB4- | Output         | Phase B Top CMD or DAC Strobe           |                                                                                    |
| 91                          | PWMBBOT4+<br>DAC4B+    | Output         | Phase B Bottom CMD or DAC B Serial Data | Programmable function control                                                      |
| 92                          | PWMBBOT4-<br>DAC4B-    | Output         | Phase B Bottom CMD or DAC B Serial Data |                                                                                    |
| 93                          | PWMCTOP4+<br>DIR4+     | Output         | Phase B Top CMD or PFM Direction        | Programmable function control                                                      |
| 94                          | PWMCTOP4-<br>DIR4-     | Output         | Phase B Top CMD or PFM Direction        |                                                                                    |
| 95                          | PWMCBOT4+<br>PULSE4+   | Output         | Phase B Bottom CMD or PFM Pulse         | Programmable function control                                                      |
| 96                          | PWMCBOT4-<br>PULSE4-   | Output         | Phase B Bottom CMD or PFM Pulse         |                                                                                    |
| 97                          | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 98                          | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 99                          | +5V                    | Output / Input | +5V Power                               | For external circuit or from external supply                                       |
| 100                         | +5V                    | Output / Input | +5V Power                               |                                                                                    |

The JMACH2 connector provides the interface pins for channels 3 and 4. Usually, it is connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board.

**Note:** 100-pin male box header with center key, 0050 pitch. AMP part # 1-04068-7. Delta Tau part # 014-00010-FPB.

| P1 JMACH (96-Pin Header) |          |                                                                                    |           |
|--------------------------|----------|------------------------------------------------------------------------------------|-----------|
|                          |          |  |           |
| Pin #                    | Row A    | Row B                                                                              | Row C     |
| 01                       | D00      | BBSY/                                                                              | D08       |
| 02                       | D01      | BCLR/                                                                              | D09       |
| 03                       | D02      | ACFAIL/                                                                            | D10       |
| 04                       | D03      | B0IN/                                                                              | D11       |
| 05                       | D04      | BG0OUT/                                                                            | D12       |
| 06                       | D05      | BG1IN/                                                                             | D13       |
| 07                       | D06      | BG1OUT/                                                                            | D14       |
| 08                       | D07      | BG2IN/                                                                             | D15       |
| 09                       | GND      | BG2OUT/                                                                            | GND       |
| 10                       | SYSCLK   | BG3IN/                                                                             | SYSFAIL/  |
| 11                       | GND      | BG3OUT/                                                                            | BERR/     |
| 12                       | DS1/     | BR0/                                                                               | SYSRESET/ |
| 13                       | DS0/     | BR1/                                                                               | LWORD/    |
| 14                       | WRITE/   | BR2/                                                                               | AM5       |
| 15                       | GND      | BR3/                                                                               | A23       |
| 16                       | DTACK/   | AM0                                                                                | A22       |
| 17                       | GND      | AM1                                                                                | A21       |
| 18                       | AS/      | AM2                                                                                | A20       |
| 19                       | GND      | AM3                                                                                | A19       |
| 20                       | IACK/    | GND                                                                                | A18       |
| 21                       | IACKIN/  | SERCLK                                                                             | A17       |
| 22                       | IACKOUT/ | SERDAT/                                                                            | A16       |
| 23                       | AM4      | GND                                                                                | A15       |
| 24                       | A07      | IRQ7/                                                                              | A14       |
| 25                       | A06      | IRQ6/                                                                              | A13       |
| 26                       | A05      | IRQ5/                                                                              | A12       |
| 27                       | A04      | IRQ4/                                                                              | A11       |
| 28                       | A03      | IRQ3/                                                                              | A10       |
| 29                       | A02      | IRQ2/                                                                              | A09       |
| 30                       | A01      | IRQ1/                                                                              | A08       |
| 31                       | -12V     | +5V STDBY                                                                          | +12V      |
| 32                       | +5V      | +5V                                                                                | +5V       |

This is the standard VME connector. It is sufficient for 16-bit or 24-bit addressing and for 8-bit or 16-bit data. For 32-bit addressing the b-row of P2 must be used as well. PMAC does not support 32-bit data transfers over the bus, even with the b-row of P2. If P1 is connected to the VME backplane, PMAC is connected to the +5V supply and GND automatically. In this case, no other +5V supply should be connected.

| P2/JMACHA (96-Pin Header) |                       |                  |  |                       |
|---------------------------|-----------------------|------------------|------------------------------------------------------------------------------------|-----------------------|
|                           |                       |                  | Front View                                                                         |                       |
| Pin#                      | Row A                 | Row B (Format A) | Row B (Format B)                                                                   | Row C                 |
| 01                        | +5V                   | +5V              | CHU1                                                                               | +5V                   |
| 02                        | GND                   | GND              | CHU3                                                                               | GND                   |
| 03                        | CHA1                  | (Reserved)       | CHV1                                                                               | CHA3                  |
| 04                        | CHB1                  | VA24             | CHV3                                                                               | CHB3                  |
| 05                        | CHC1                  | VA25             | CHW1                                                                               | CHC3                  |
| 06                        | PLIM1                 | VA26             | CHW3                                                                               | PLIM3                 |
| 07                        | MLIM1                 | VA27             | CHT1                                                                               | MLIM3                 |
| 08                        | HOME1                 | VA28             | CHT3                                                                               | HOME3                 |
| 09                        | AENA1                 | VA29             | USER1                                                                              | AENA3                 |
| 10                        | FAULT1                | VA30             | USER3                                                                              | FAULT3                |
| 11                        | PWMATOP1/<br>DAC_CLK1 | VA31             | ADC_DAA1                                                                           | PWMATOP3/<br>DAC_CLK3 |
| 12                        | PWMABOT1/ DAC1A       | GND              | ADC_DAA3                                                                           | PWMABOT3/ DAC3A       |
| 13                        | PWMBTOP1/<br>DAC_STB1 | +5V              | ADC_DAB1                                                                           | PWMBTOP3/<br>DAC_STB3 |
| 14                        | PWMBBOT1/ DAC1B       | VD16 (not used)  | ADC_DAB3                                                                           | PWMBBOT3/ DAC3B       |
| 15                        | PWMCTOP1/ DIR1        | VD17 (not used)  | ADC_CLK1234                                                                        | PWMCTOP3/ DIR3        |
| 16                        | PWMCBOT1/ PULSE1      | VD18 (not used)  | ADC_STB1234                                                                        | PWMCBOT3/ PULSE3      |
| 17                        | CHA2                  | VD19 (not used)  | SCLK1234                                                                           | CHA4                  |
| 18                        | CHB2                  | VD20 (not used)  | WD0/                                                                               | CHB4                  |
| 19                        | CHC2                  | VD21 (not used)  | CHU2                                                                               | CHC4                  |
| 20                        | PLIM2                 | VD22 (not used)  | CHU4                                                                               | PLIM4                 |
| 21                        | MLIM2                 | VD23 (not used)  | CHV2                                                                               | MLIM4                 |
| 22                        | HOME2                 | GND              | CHV4                                                                               | HOME4                 |
| 23                        | AENA2                 | VD24 (not used)  | CHW2                                                                               | AENA4                 |
| 24                        | FAULT2                | VD25 (not used)  | CHW4                                                                               | FAULT4                |
| 25                        | PWMATOP2/<br>DAC_CLK2 | VD26 (not used)  | CHT2                                                                               | PWMATOP4/<br>DAC_CLK4 |
| 26                        | PWMABOT2/ DAC2A       | VD27 (not used)  | CHT4                                                                               | PWMABOT4/ DAC4A       |
| 27                        | PWMBTOP2/<br>DAC_STB2 | VD28 (not used)  | USER2                                                                              | PWMBTOP4/<br>DAC_STB4 |
| 28                        | PWMBBOT2/ DAC2B       | VD29 (not used)  | USER4                                                                              | PWMBBOT4/ DAC4B       |
| 29                        | PWMCTOP2/ DIR2        | VD30 (not used)  | ADC_DAA2                                                                           | PWMCTOP4/ DIR4        |
| 30                        | PWMCBOT2/ PULSE2      | VD31 (not used)  | ADC_DAA4                                                                           | PWMCBOT4/ PULSE4      |
| 31                        | GND                   | GND              | ADC_DAB2                                                                           | GND                   |
| 32                        | +5V                   | +5V              | ADC_DAB4                                                                           | +5V                   |

The P2 connector provides an alternate path to J9 and J10 for the machine interface connections for channels 1-4. Only the positive signals of complementary pairs are brought out on this connector. For the inputs, the complementary lines are tied to 2.5V on PMAC2. Refer to the J9 and J10 pin descriptions for more detailed information on each pin.

**Note:** Format A for the B-row will be used if E7A-H, E8A-H, E9A-H, and E10A-H connect pins 2 and 3. This format must be used for a 32-bit VME system. Format B for the B-row will be used if these jumpers connect pins 1 and 2. This format is not compatible with 32-bit VME systems.

| TB1 (2/4-Pin Terminal Block)                                                                                                                                                                                                                                                                                                                |        |          |                         |                                                                            |
|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------|-------------------------|----------------------------------------------------------------------------|
|                                                                                                                                                                                                                                                                                                                                             |        |          |                         |                                                                            |
| Pin#                                                                                                                                                                                                                                                                                                                                        | Symbol | Function | Description             | Notes                                                                      |
| 1                                                                                                                                                                                                                                                                                                                                           | GND    | Common   | Reference Voltage       |                                                                            |
| 2                                                                                                                                                                                                                                                                                                                                           | +5V    | Input    | Positive Supply Voltage | Supplies all PMAC digital circuits                                         |
| 3                                                                                                                                                                                                                                                                                                                                           | +12V   | Input    | Positive Supply Voltage | +12v to +15v; not required on-board; used on j1 to supply analog inputs    |
| 4                                                                                                                                                                                                                                                                                                                                           | -12V   | Input    | Negative Supply Voltage | -12V to -15V; required for Opt-12 ADCs; used on J1 to supply analog inputs |
| This terminal block can be used to provide the input for the power supply for the circuits on the PMAC2 board when it is not in a bus configuration. When the PMAC2 is in a bus configuration, these supplies come through the bus connector automatically from the bus power supply; in this case, this terminal block should not be used. |        |          |                         |                                                                            |

| TB2 (3-Pin Terminal Block)                                                                                                                                                                                                                                                                                                                                                    |        |          |                    |                 |
|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------|----------|--------------------|-----------------|
|                                                                                                                                                                                                                                                                                                                                                                               |        |          |                    |                 |
| Pin#                                                                                                                                                                                                                                                                                                                                                                          | Symbol | Function | Description        | Notes           |
| 1                                                                                                                                                                                                                                                                                                                                                                             | WD_NC  | Output   | Watchdog Relay Out | Normally closed |
| 2                                                                                                                                                                                                                                                                                                                                                                             | COM    | Input    | Watchdog Return    | +V or 0V        |
| 3                                                                                                                                                                                                                                                                                                                                                                             | WD_NO  | Output   | Watchdog Relay Out | Normally open   |
| 4                                                                                                                                                                                                                                                                                                                                                                             | COM    | Input    | Watchdog Return    | +V or 0V        |
| This terminal block provides the output for PMAC2's watchdog timer relay, both normally open and normally closed contacts. The normally closed relay contact is open while PMAC2 is operating properly (it has power and the watchdog timer is not tripped) and closed when the PMAC2 is not operating properly (either it has lost power or the watchdog timer has tripped). |        |          |                    |                 |

## JUMPER SUMMARY

See PMAC2 VME layout diagram for jumper locations.

### E1: Card 0 Select

| E Point and Physical Layout                                                                    | Location | Description                                                                                                                                                                                                                                                                 | Default             |
|------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>E1</b><br> | B1       | Remove jumper to specify that this is Card 0, which generates its own phase and servo clock (default).<br>Jump pins 1 to 2 to specify that this is not card 0, but Card 1 to F (15), which requires external phase and servo clock signals from the serial port to operate. | No jumper installed |

### E2: 40 MHz/60 MHz CPU Operation

**Caution:**

Operation of a board with 40 MHz components (standard) at 60 MHz is done completely at the user's own risk; Delta Tau can accept no responsibility for the operation of PMAC2 or the machine under these conditions.

It may be possible to operate a board with 40 MHz components (standard) at 60 MHz under some conditions by changing the setting of jumper E2. However, this operates the components outside of their specified operating range, and proper execution of PMAC2 under these conditions is not guaranteed. PMAC software failure is possible, even probable, under these conditions, and this can lead to very dangerous machine failure.

| E Point and Physical Layout                                                                      | Location | Description                                                                                                                                                                 | Default                                                            |
|--------------------------------------------------------------------------------------------------|----------|-----------------------------------------------------------------------------------------------------------------------------------------------------------------------------|--------------------------------------------------------------------|
| <b>E2</b><br> | B2       | Remove jumper to specify 40 MHz operation of the PMAC CPU (2 x crystal frequency).<br>Jump pins 1 to 2 to specify 60 MHz operation of the PMAC CPU (3 x crystal frequency). | No jumper installed (standard)<br>1-2 jumper installed (Option 5B) |

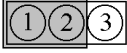
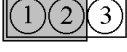
### E3: Re-Initialization on Reset Control

| E Point and Physical Layout                                                                      | Location | Description                                                                                        | Default             |
|--------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------|---------------------|
| <b>E3</b><br> | B2       | Remove jumper for normal reset mode (default).<br>Jump pins 1 to 2 for re-initialization on reset. | No jumper installed |

### E4 - E6: (Reserved for future use)

| E Point and Physical Layout                                                                           | Location | Description | Default             |
|-------------------------------------------------------------------------------------------------------|----------|-------------|---------------------|
| <b>E4 - E6</b><br> | B2       |             | No jumper installed |

## E7A-H through E10A-H: P2 Connector B-Row Use Select

| E Point and Physical Layout                                                                        | Location | Description                                                                                                                                                                  | Default                            |
|----------------------------------------------------------------------------------------------------|----------|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------------------------------------|
| <b>E7A-H</b><br>  | B5       | Jump pins 1 to 2 to use B-row of P2 connector for JMACH pins (not compatible with 32-bit VME).<br>Jump pins 2 to 3 to use B-row of P2 connector for 32-bit VME bus interface | 1-2 jumpers installed              |
| <b>E8A-H</b><br>  | B5       | Jump pins 1 to 2 to use B-row of P2 connector for JMACH pins (not compatible with 32-bit VME).<br>Jump pins 2 to 3 to use B-row of P2 connector for 32-bit VME bus interface | 1-2 jumpers installed              |
| <b>E9A-H</b><br>  | A5       | Jump pins 1 to 2 to use B-row of P2 connector for JMACH pins (not compatible with 32-bit VME).<br>Jump pins 2 to 3 to use B-row of P2 connector for 32-bit VME bus interface | 1-2 jumpers installed              |
| <b>E10A-H</b><br> | A5       | Jump pins 1 to 2 to use B-row of P2 connector for JMACH pins (not compatible with 32-bit VME).<br>Jump pins 2 to 3 to use B-row of P2 connector for 32-bit VME bus interface | 1-2 jumpers installed (32-bit VME) |

**Note:** All jumpers in the E7 to E10 families must be in the same setting.

## E11-E12: JEQU Port Sink/Source Select

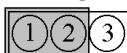
| E Point and Physical Layout                                                                       | Location | Description                                                                                                                                                                     | Default               |
|---------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>E11</b><br> | A1       | Jump pins 1 to 2 for sinking driver (ULN2803A) on JEQU port (default configuration).<br>Jump pins 2 to 3 for sourcing driver (UDN2981A) on JEQU port (alternate configuration). | 1-2 jumpers installed |
| <b>E12</b><br> | A1       | Jump pins 1 to 2 for sinking driver (ULN2803A) on JEQU port (default configuration).<br>Jump pins 2 to 3 for sourcing driver (UDN2981A) on JEQU port (alternate configuration). | 1-2 jumpers installed |

## E13: SCLK Direction Control

| E Point and Physical Layout                                                                       | Location | Description                                                                                                                                                                                                                                                                                                                   | Default             |
|---------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>E13</b><br> | A1       | Remove jumper to output SCLK generated in first ASIC on SCLK_12 and SCLK_34, or to control direction by software.<br>Jump pins 1 to 2 to input SCLK signal for first ASIC on SCLK_34 and output this signal on SCLK_12.<br>Jump pins 2 to 3 to input SCLK signal for first ASIC on SCLK_12 and output this signal on SCLK_34. | No jumper installed |

## E17 - E18: Serial Connector Select

E17 and E18 control whether the RS-232 or RS-422 serial port is used.

| E Point and Physical Layout                                                                     | Location | Description                                                                                           | Default              |
|-------------------------------------------------------------------------------------------------|----------|-------------------------------------------------------------------------------------------------------|----------------------|
| <b>E17</b><br> | B2       | Jump pins 1 to 2 to use RS-232 serial interface.<br>Jump pins 2 to 3 to use RS -422 serial interface  | 1-2 jumper installed |
| <b>E18</b><br> | C2       | Jump pins 1 to 2 to use RS -232 serial interface.<br>Jump pins 2 to 3 to use RS -422 serial interface | 1-2 jumper installed |

## E20A-I: DPRAM Byte Order Control

### Caution:

All E20A-I jumpers must be in the same setting for DPRAM communications to work.

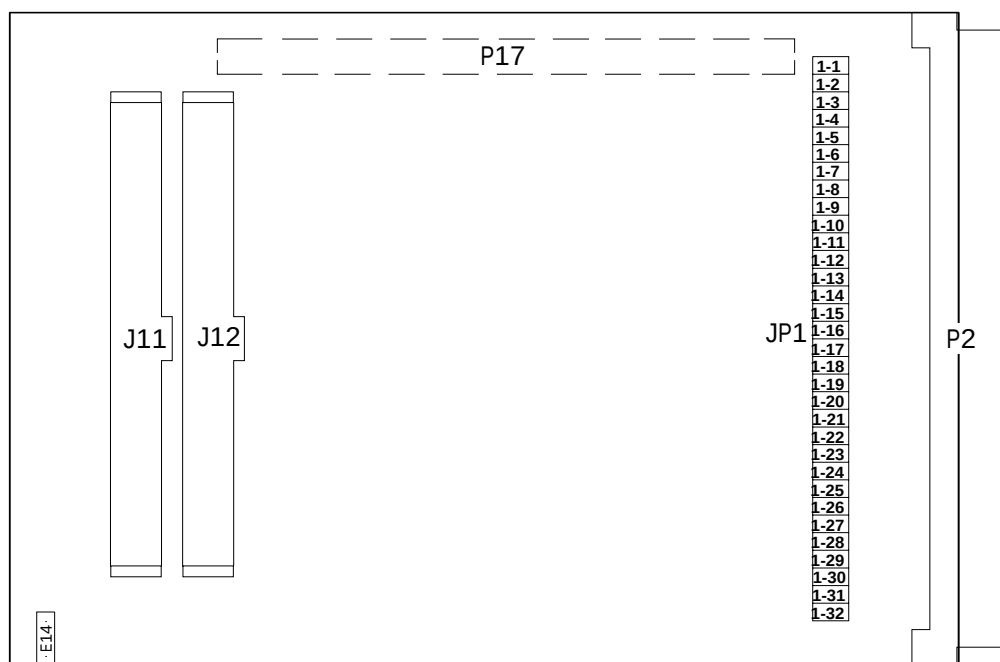
| E Point and Physical Layout                                                                                                                                                                                                                          | Location                                           | Description                                                                                                                                                                                                                                                                                                                                                   | Default                                      |
|------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------------------------------------------|
| <b>E20</b><br><b>A</b> 5 (4 3) (2 1)<br><b>B</b> 5 (4 3) (2 1)<br><b>C</b> 5 (4 3) (2 1)<br><b>D</b> 5 (4 3) (2 1)<br><b>E</b> 5 (4 3) (2 1)<br><b>F</b> 5 (4 3) (2 1)<br><b>G</b> 5 (4 3) (2 1)<br><b>H</b> 5 (4 3) (2 1)<br><b>I</b> 5 (4 3) (2 1) | C4<br>C4<br>C4<br>C4<br>C4<br>D4<br>D4<br>D4<br>D4 | Jump pins 1 to 2, and pins 3 to 4, to tie DPRAM data lines 8-15 to VME Bus data lines 8-15, and DPRAM data lines 0-7 to VME Bus data lines 0-7 (Motorola big-endian format)<br><br>Jump pins 2 to 3, and pins 4 to 5 to tie DPRAM data lines 8-15 to VME Bus data lines 0-7, and DPRAM data lines 0-7 to VME Bus data lines 8-15 (Intel little-endian format) | 1-2, 3-4 jumpers installed (Motorola format) |

## E39: Reset-From-Bus Enable

| E Point and Physical Layout                                                                       | Location | Description                                                                                                               | Default              |
|---------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------|----------------------|
| <b>E39</b><br> | D1       | Jump pin 1 to 2 to permit VME Bus reset line to reset PMAC2.<br>Remove jumper so VME Bus reset line does not reset PMAC2. | 1-2 jumper installed |

## Option 1V Piggyback Connector Description

The following paragraphs provide a brief description of each connector on the Option 1V Piggyback card, its use, and individual pinout information (see Figure 2-2).



| J11/JMACH3 (100-Pin Header) |           |                |                           | Front View                                   |
|-----------------------------|-----------|----------------|---------------------------|----------------------------------------------|
| Pin#                        | Symbol    | Function       | Description               | Notes                                        |
| 1                           | +5V       | Output / Input | +5V Power                 | For external circuit or from external supply |
| 2                           | +5V       | Output / Input | +5V Power                 |                                              |
| 3                           | GND       | Common         | Reference Voltage         |                                              |
| 4                           | GND       | Common         | Reference Voltage         |                                              |
| 5                           | CHA5+     | Input          | Enc 5 Pos. A Chan.        | Also pulse input                             |
| 6                           | CHA5-     | Input          | Enc 5 Neg. A Chan.        |                                              |
| 7                           | CHB5+     | Input          | Enc 5 Pos. B Chan.        | Also direction input                         |
| 8                           | CHB5-     | Input          | Enc 5 Neg. B Chan.        |                                              |
| 9                           | CHC5+     | Input          | Enc 5 Pos. C Chan.        | Index channel                                |
| 10                          | CHC5-     | Input          | Enc 5 Neg. C Chan.        |                                              |
| 11                          | CHU5      | Input          | Chan 5 U Flag             | Hall effect, fault code, or sub-count        |
| 12                          | CHV5      | Input          | Chan 5 V Flag             | Hall effect, fault code, or sub-count        |
| 13                          | CHW5      | Input          | Chan 5 W Flag             | Hall effect, fault code, or sub-count        |
| 14                          | CHT5      | Input          | Chan 5 T Flag             | Fault code, or sub-count                     |
| 15                          | USER5     | Input          | General Purpose User Flag | Hardware capture flag, or sub-count          |
| 16                          | PLIM5     | Input          | Positive Overtravel Limit | Hardware capture flag                        |
| 17                          | MLIM5     | Input          | Negative Overtravel Limit | Hardware capture flag                        |
| 18                          | HOME5     | Input          | Home Switch Input         | Hardware capture flag                        |
| 19                          | ACCFLT5   | Input          | Accessory Fault Flag      | For loss of acc supply voltage               |
| 20                          | WD0/      | Output         | Watchdog Output           | Low is PMAC Watchdog Fault                   |
| 21                          | SCLK56+   | Input / Output | Encoder Sample Clock      | Direction controlled by PMAC2 jumper         |
| 22                          | SCLK56-   | Input / Output | Encoder Sample Clock      |                                              |
| 23                          | ADC_CLK5+ | Output         | A/D Converter Clock       | Programmable frequency                       |
| 24                          | ADC_CLK5- | Output         | A/D Converter Clock       |                                              |

| J11/JMACH3 (100-Pin Header) |                        |                |                                         |  |
|-----------------------------|------------------------|----------------|-----------------------------------------|------------------------------------------------------------------------------------|
| Pin#                        | Symbol                 | Function       | Description                             | Notes                                                                              |
| 25                          | ADC_STB5+              | Output         | A/D Converter Strobe                    | Programmable sequence                                                              |
| 26                          | ADC_STB5-              | Output         | A/D Converter Strobe                    |                                                                                    |
| 27                          | ADC_DAA5+              | Input          | Chan A ADC Serial Data                  | MSB first                                                                          |
| 28                          | ADC_DAA5-              | Input          | Chan A ADC Serial Data                  |                                                                                    |
| 29                          | ADC_DAB5+              | Input          | Chan B ADC Serial Data                  | MSB first                                                                          |
| 30                          | ADC_DAB5-              | Input          | Chan B ADC Serial Data                  |                                                                                    |
| 31                          | AENA5+                 | Output         | Amplifier Enable                        | High is enable                                                                     |
| 32                          | AENA5-                 | Output         | Amplifier Enable                        | Low is enable                                                                      |
| 33                          | FAULT5+                | Input          | Amplifier Fault                         | Programmable polarity                                                              |
| 34                          | FAULT5-                | Input          | Amplifier Fault                         |                                                                                    |
| 35                          | PWMATOP5+<br>DAC_CLK5+ | Output         | Phase A Top CMD or DAC Clock            | Programmable function control                                                      |
| 36                          | PWMATOP5-<br>DAC_CLK5- | Output         | Phase A Top CMD or DAC Clock            |                                                                                    |
| 37                          | PWMABOT5+<br>DAC5A+    | Output         | Phase A Bottom CMD or DAC A Serial Data | Programmable function control                                                      |
| 38                          | PWMABOT5-<br>DAC5A-    | Output         | Phase A Bottom CMD or DAC A Serial Data |                                                                                    |
| 39                          | PWMBTOP5+<br>DAC_STB5+ | Output         | Phase B Top CMD or DAC Strobe           | Programmable function control                                                      |
| 40                          | PWMBTOP5-<br>DAC_STB5- | Output         | Phase B Top CMD or DAC Strobe           |                                                                                    |
| 41                          | PWMBBOT5+<br>DAC5B+    | Output         | Phase B Bottom CMD or DAC B Serial Data | Programmable function control                                                      |
| 42                          | PWMBBOT5-<br>DAC5B-    | Output         | Phase B Bottom CMD or DAC B Serial Data |                                                                                    |
| 43                          | PWMCTOP5+<br>DIR5+     | Output         | Phase B Top CMD or PFM Direction        | Programmable function control                                                      |
| 44                          | PWMCTOP5-<br>DIR5-     | Output         | Phase B Top CMD or PFM Direction        |                                                                                    |
| 45                          | PWMCBOT5+<br>PULSE5+   | Output         | Phase B Bottom CMD or PFM Pulse         | Programmable function control                                                      |
| 46                          | PWMCBOT5-<br>PULSE5-   | Output         | Phase B Bottom CMD or PFM Pulse         |                                                                                    |
| 47                          | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 48                          | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 49                          | +5V                    | Output / Input | +5V Power                               | For external circuit or from external supply                                       |
| 50                          | +5V                    | Output / Input | +5V Power                               |                                                                                    |
| 51                          | +5V                    | Output / Input | +5V Power                               | For external circuit or from external supply                                       |
| 52                          | +5V                    | Output / Input | +5V Power                               |                                                                                    |
| 53                          | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 54                          | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 55                          | CHA6+                  | Input          | Enc 6 Pos. A Chan.                      | Also pulse input                                                                   |
| 56                          | CHA6-                  | Input          | Enc 6 Neg. A Chan.                      |                                                                                    |
| 57                          | CHB6+                  | Input          | Enc 6 Pos. B Chan.                      | Also direction input                                                               |
| 58                          | CHB6-                  | Input          | Enc 6 Neg. B Chan.                      |                                                                                    |
| 59                          | CHC6+                  | Input          | Enc 6 Pos. C Chan.                      | Index channel                                                                      |
| 60                          | CHC6-                  | Input          | Enc 6 Neg. C Chan.                      |                                                                                    |
| 61                          | CHU6                   | Input          | Chan 6 U Flag                           | Hall effect, fault code, or sub-count                                              |
| 62                          | CHV6                   | Input          | Chan 6 V Flag                           | Hall effect, fault code, or sub-count                                              |

| J11/JMACH3 (100-Pin Header) |                        |                |                                           |  |
|-----------------------------|------------------------|----------------|-------------------------------------------|------------------------------------------------------------------------------------|
| Pin#                        | Symbol                 | Function       | Description                               | Notes                                                                              |
| 63                          | CHW6                   | Input          | Chan 6 W Flag                             | Hall effect, fault code, or sub-count                                              |
| 64                          | CHT6                   | Input          | Chan 6 T Flag                             | Fault code, or sub-count                                                           |
| 65                          | USER6                  | Input          | General Purpose User Flag                 | Hardware capture flag, or sub-count                                                |
| 66                          | PLIM6                  | Input          | Positive Overtravel Limit                 | Hardware capture flag                                                              |
| 67                          | MLIM6                  | Input          | Negative Overtravel Limit                 | Hardware capture flag                                                              |
| 68                          | HOME6                  | Input          | Home Switch Input                         | Hardware capture flag                                                              |
| 69                          | ACCFLT6                | Input          | Accessory Fault Flag                      | For loss of ACC supply voltage                                                     |
| 70                          | WD0/                   | Output         | Watchdog Output                           | Low is PMAC watchdog fault                                                         |
| 71                          | SCLK56+                | Input / Output | Encoder Sample Clock                      | Direction controlled by PMAC2 jumper                                               |
| 72                          | SCLK56-                | Input / Output | Encoder Sample Clock                      |                                                                                    |
| 73                          | ADC_CLK6+              | Output         | A/D Converter Clock                       | Programmable frequency                                                             |
| 74                          | ADC_CLK6-              | Output         | A/D Converter Clock                       |                                                                                    |
| 75                          | ADC_STB6+              | Output         | A/D Converter Strobe                      | Programmable sequence                                                              |
| 76                          | ADC_STB6-              | Output         | A/D Converter Strobe                      |                                                                                    |
| 77                          | ADC_DAA6+              | Input          | Chan A ADC Serial Data                    | MSB first                                                                          |
| 78                          | ADC_DAA6-              | Input          | Chan A ADC Serial Data                    |                                                                                    |
| 79                          | ADC_DAB6+              | Input          | Chan B ADC Serial Data                    | MSB first                                                                          |
| 80                          | ADC_DAB6-              | Input          | Chan B ADC Serial Data                    |                                                                                    |
| 81                          | AENA6+                 | Output         | Amplifier Enable                          | High is enable                                                                     |
| 82                          | AENA6-                 | Output         | Amplifier Enable                          | Low is enable                                                                      |
| 83                          | FAULT6+                | Input          | Amplifier Fault                           | Programmable polarity                                                              |
| 84                          | FAULT6-                | Input          | Amplifier Fault                           |                                                                                    |
| 85                          | PWMATOP6+<br>DAC_CLK6+ | Output         | Phase A Top CMD or DAC Clock              | Programmable function control                                                      |
| 86                          | PWMATOP6-<br>DAC_CLK6- | Output         | Phase A Top CMD or DAC Clock              |                                                                                    |
| 87                          | PWMABOT6+<br>DAC6A+    | Output         | Phase A Bottom CMD or DAC A Serial Data   | Programmable function control                                                      |
| 88                          | PWMABOT6-<br>DAC6A-    | Output         | Phase A Bottom CMD or DAC A Serial Data   |                                                                                    |
| 89                          | PWMBTOP6+<br>DAC_STB6+ | Output         | Phase B Top CMD or DAC Strobe             | Programmable function control                                                      |
| 90                          | PWMBTOP6-<br>DAC_STB6- | Output         | Phase B Top CMD or DAC Strobe             |                                                                                    |
| 91                          | PWMBBOT6+<br>DAC6B+    | Output         | Phase B Bottom CMD or DAC B Serial Data   | Programmable function control                                                      |
| 92                          | PWMBBOT6-<br>DAC6B-    | Output         | Phase B Bottom CMD or DAC c B Serial Data |                                                                                    |
| 93                          | PWMCTOP6+<br>DIR6+     | Output         | Phase B Top CMD or PFM Direction          | Programmable function control                                                      |
| 94                          | PWMCTOP6-<br>DIR6-     | Output         | Phase B Top CMD or PFM Direction          |                                                                                    |
| 95                          | PWMCBOT6+<br>PULSE6+   | Output         | Phase B Bottom CMD or PFM Pulse           | Programmable function control                                                      |
| 96                          | PWMCBOT6-<br>PULSE6-   | Output         | Phase B Bottom CMD or PFM Pulse           |                                                                                    |
| 97                          | GND                    | Common         | Reference Voltage                         |                                                                                    |

|     |     |                |                   |                                              |
|-----|-----|----------------|-------------------|----------------------------------------------|
| 98  | GND | Common         | Reference Voltage |                                              |
| 99  | +5V | Output / Input | +5v Power         | For external circuit or from external supply |
| 100 | +5V | Output / Input | +5v Power         |                                              |

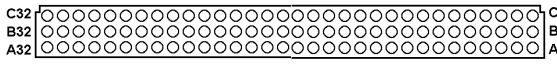
The JMACH3 connector provides the interface pins for channels 5 and 6. It is usually connected to a breakout board, such as one of the Acc-8x family of boards, or an application-specific interface board.

**Note:** 100-pin male box header with center key, 0050 pitch. AMP part # 1-04068-7.  
Delta Tau part # 014-00010-FPB.

| J12/JMACH4 (100-Pin Header) |                        |                |                                         |  |
|-----------------------------|------------------------|----------------|-----------------------------------------|------------------------------------------------------------------------------------|
|                             |                        |                |                                         | Front View                                                                         |
| Pin#                        | Symbol                 | Function       | Description                             | Notes                                                                              |
| 1                           | +5V                    | Output / Input | +5V Power                               | For external circuit or from external supply                                       |
| 2                           | +5V                    | Output / Input | +5V Power                               |                                                                                    |
| 3                           | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 4                           | GND                    | Common         | Reference Voltage                       |                                                                                    |
| 5                           | CHA7+                  | Input          | Enc 7 Pos. A Chan.                      | Also pulse input                                                                   |
| 6                           | CHA7-                  | Input          | Enc 7 Neg. A Chan.                      |                                                                                    |
| 7                           | CHB7+                  | Input          | Enc 7 Pos. B Chan.                      | Also direction input                                                               |
| 8                           | CHB7-                  | Input          | Enc 7 Neg. B Chan.                      |                                                                                    |
| 9                           | CHC7+                  | Input          | Enc 7 Pos. C Chan.                      | Index channel                                                                      |
| 10                          | CHC7-                  | Input          | Enc 7 Neg. C Chan.                      |                                                                                    |
| 11                          | CHU7                   | Input          | Chan 7 U Flag                           | Hall effect, fault code, or sub-count                                              |
| 12                          | CHV7                   | Input          | Chan 7 V Flag                           | Hall effect, fault code, or sub-count                                              |
| 13                          | CHW7                   | Input          | Chan 7 W Flag                           | Hall effect, fault code, or sub-count                                              |
| 14                          | CHT7                   | Input          | Chan 7 T Flag                           | Fault code, or sub-count                                                           |
| 15                          | USER7                  | Input          | General Purpose User Flag               | Hardware capture flag, or sub-count                                                |
| 16                          | PLIM7                  | Input          | Positive Overtravel Limit               | Hardware capture flag                                                              |
| 17                          | MLIM7                  | Input          | Negative Overtravel Limit               | Hardware capture flag                                                              |
| 18                          | HOME7                  | Input          | Home Switch Input                       | Hardware capture flag                                                              |
| 19                          | ACCFLT7                | Input          | Accessory Fault Flag                    | For loss of ACC supply voltage                                                     |
| 20                          | WD0/                   | Output         | Watchdog Output                         | Low is PMAC watchdog fault                                                         |
| 21                          | SCLK78+                | Input / Output | Encoder Sample Clock                    | Direction controlled by PMAC2 jumper                                               |
| 22                          | SCLK78-                | Input / Output | Encoder Sample Clock                    |                                                                                    |
| 23                          | ADC_CLK7+              | Output         | A/D Converter Clock                     | Programmable frequency                                                             |
| 24                          | ADC_CLK7-              | Output         | A/D Converter Clock                     |                                                                                    |
| 25                          | ADC_STB7+              | Output         | A/D Converter Strobe                    | Programmable sequence                                                              |
| 26                          | ADC_STB7-              | Output         | A/D Converter Strobe                    |                                                                                    |
| 27                          | ADC_DAA7+              | Input          | Chan A ADC Serial Data                  | MSB first                                                                          |
| 28                          | ADC_DAA7-              | Input          | Chan A ADC Serial Data                  |                                                                                    |
| 29                          | ADC_DAB7+              | Input          | Chan B ADC Serial Data                  | MSB first                                                                          |
| 30                          | ADC_DAB7-              | Input          | Chan B ADC Serial Data                  |                                                                                    |
| 31                          | AENA7+                 | Output         | Amplifier Enable                        | High is enable                                                                     |
| 32                          | AENA7-                 | Output         | Amplifier Enable                        | Low is enable                                                                      |
| 33                          | FAULT7+                | Input          | Amplifier Fault                         | Programmable polarity                                                              |
| 34                          | FAULT7-                | Input          | Amplifier Fault                         |                                                                                    |
| 35                          | PWMATOP7+<br>DAC_CLK7+ | Output         | Phase A Top CMD or DAC Clock            | Programmable function control                                                      |
| 36                          | PWMATOP7-<br>DAC_CLK7- | Output         | Phase A Top CMD or DAC Clock            |                                                                                    |
| 37                          | PWMABOT7+<br>DAC7A+    | Output         | Phase A Bottom CMD or DAC A Serial Data | Programmable function control                                                      |
| 38                          | PWMABOT7-<br>DAC7A-    | Output         | Phase A Bottom CMD or DAC A Serial Data |                                                                                    |

| J12/JMACH4 (100-Pin Header) |                        |                |  |                                              |
|-----------------------------|------------------------|----------------|------------------------------------------------------------------------------------|----------------------------------------------|
| Pin#                        | Symbol                 | Function       | Description                                                                        | Notes                                        |
| 39                          | PWMBTOP7+<br>DAC_STB7+ | Output         | Phase B Top CMD or DAC Strobe                                                      | Programmable function control                |
| 40                          | PWMBTOP3-<br>DAC_STB7- | Output         | Phase B Top CMD or DAC Strobe                                                      |                                              |
| 41                          | PWMBBOT7+<br>DAC7B+    | Output         | Phase B Bottom CMD or DAC B Serial Data                                            | Programmable function control                |
| 42                          | PWMBBOT7-<br>DAC7B-    | Output         | Phase B Bottom CMD or DAC B Serial Data                                            |                                              |
| 43                          | PWMCTOP7+<br>DIR7+     | Output         | Phase B Top CMD or PFM Direction                                                   | Programmable function control                |
| 44                          | PWMCTOP7-<br>DIR7-     | Output         | Phase B Top CMD or PFM Direction                                                   |                                              |
| 45                          | PWMCBOT7+<br>PULSE7+   | Output         | Phase B Bottom CMD or PFM Pulse                                                    | Programmable function control                |
| 46                          | PWMCBOT7-<br>PULSE7-   | Output         | Phase B Bottom CMD or PFM Pulse                                                    |                                              |
| 47                          | GND                    | Common         | Reference Voltage                                                                  |                                              |
| 48                          | GND                    | Common         | Reference Voltage                                                                  |                                              |
| 49                          | +5V                    | Output / Input | +5V Power                                                                          | For external circuit or from external supply |
| 50                          | +5V                    | Output / Input | +5V Power                                                                          |                                              |
| 51                          | +5V                    | Output / Input | +5V Power                                                                          | For external circuit or from external supply |
| 52                          | +5V                    | Output / Input | +5V Power                                                                          |                                              |
| 53                          | GND                    | Common         | Reference Voltage                                                                  |                                              |
| 54                          | GND                    | Common         | Reference Voltage                                                                  |                                              |
| 55                          | CHA8+                  | Input          | Enc 8 Pos. A Chan.                                                                 | Also pulse input                             |
| 56                          | CHA8-                  | Input          | Enc 8 Neg. A Chan.                                                                 |                                              |
| 57                          | CHB8+                  | Input          | Enc 8 Pos. B Chan.                                                                 | Also direction input                         |
| 58                          | CHB8-                  | Input          | Enc 8 Neg. B Chan.                                                                 |                                              |
| 59                          | CHC8+                  | Input          | Enc 8 Pos. C Chan.                                                                 | Index channel                                |
| 60                          | CHC8-                  | Input          | Enc 8 Neg. C Chan.                                                                 |                                              |
| 61                          | CHU8                   | Input          | Chan 8 U Flag                                                                      | Hall effect, fault code, or sub-count        |
| 62                          | CHV8                   | Input          | Chan 8 V Flag                                                                      | Hall effect, fault code, or sub-count        |
| 63                          | CHW8                   | Input          | Chan 8 W Flag                                                                      | Hall effect, fault code, or sub-count        |
| 64                          | CHT8                   | Input          | Chan 8 T Flag                                                                      | Fault code, or sub-count                     |
| 65                          | USER8                  | Input          | General Purpose User Flag                                                          | Hardware capture flag, or sub-count          |
| 66                          | PLIM8                  | Input          | Positive Overtravel Limit                                                          | Hardware capture flag                        |
| 67                          | MLIM8                  | Input          | Negative Overtravel Limit                                                          | Hardware capture flag                        |
| 68                          | HOME8                  | Input          | Home Switch Input                                                                  | Hardware capture flag                        |
| 69                          | ACCFLT8                | Input          | Accessory Fault Flag                                                               | For loss of ACC supply voltage               |
| 70                          | WD0/                   | Output         | Watchdog Output                                                                    | Low is PMAC watchdog fault                   |
| 71                          | SCLK78+                | Input / Output | Encoder Sample Clock                                                               | Direction controlled by PMAC2 jumper         |
| 72                          | SCLK78-                | Input / Output | Encoder Sample Clock                                                               |                                              |
| 73                          | ADC_CLK8+              | Output         | A/D Converter Clock                                                                | Programmable frequency                       |
| 74                          | ADC_CLK8-              | Output         | A/D Converter Clock                                                                |                                              |
| 75                          | ADC_STB8+              | Output         | A/D Converter Strobe                                                               | Programmable sequence                        |
| 76                          | ADC_STB8-              | Output         | A/D Converter Strobe                                                               |                                              |
| 77                          | ADC_DAA8+              | Input          | Chan A ADC Serial Data                                                             | MSB first                                    |
| 78                          | ADC_DAA8-              | Input          | Chan A ADC Serial Data                                                             |                                              |
| 79                          | ADC_DAB8+              | Input          | Chan B ADC Serial Data                                                             | MSB first                                    |
| 80                          | ADC_DAB8-              | Input          | Chan B ADC Serial Data                                                             |                                              |

| J12/JMACH4 (100-Pin Header) |  |  |  | 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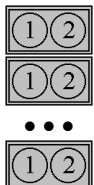
| P2A/JMACHB (96-Pin Header)                                                         |                       |                  |                  |                       |
|------------------------------------------------------------------------------------|-----------------------|------------------|------------------|-----------------------|
|  |                       |                  |                  |                       |
| Pin#                                                                               | Row A                 | Row B (Format A) | Row B (Format B) | Row C                 |
| 01                                                                                 | +5V                   | No Connect       | CHU5             | +5V                   |
| 02                                                                                 | GND                   | No Connect       | CHU7             | GND                   |
| 03                                                                                 | CHA5                  | No Connect       | CHV5             | CHA7                  |
| 04                                                                                 | CHB5                  | No Connect       | CHV7             | CHB7                  |
| 05                                                                                 | CHC5                  | No Connect       | CHW5             | CHC7                  |
| 06                                                                                 | PLIM5                 | No Connect       | CHW7             | PLIM7                 |
| 07                                                                                 | MLIM5                 | No Connect       | CHT5             | MLIM7                 |
| 08                                                                                 | HOME5                 | No Connect       | CHT7             | HOME7                 |
| 09                                                                                 | AENA5                 | No Connect       | USER5            | AENA7                 |
| 10                                                                                 | FAULT5                | No Connect       | USER7            | FAULT7                |
| 11                                                                                 | PWMATOP5/<br>DAC_CLK5 | No Connect       | ADC_DAA5         | PWMATOP7/<br>DAC_CLK7 |
| 12                                                                                 | PWMABOT5/ DAC5A       | No Connect       | ADC_DAA7         | PWMABOT7/ DAC7A       |
| 13                                                                                 | PWMBTOP5/<br>DAC_STB5 | No Connect       | ADC_DAB5         | PWMBTOP7/<br>DAC_STB7 |
| 14                                                                                 | PWMBBOT5/ DAC5B       | No Connect       | ADC_DAB7         | PWMBBOT7/ DAC7B       |
| 15                                                                                 | PWMCTOP5/ DIR5        | No Connect       | ADC_CLK5678      | PWMCTOP7/ DIR7        |
| 16                                                                                 | PWMCBOT5/ PULSE5      | No Connect       | ADC_STB5678      | PWMCBOT7/ PULSE7      |
| 17                                                                                 | CHA6                  | No Connect       | SCLK5678         | CHA8                  |
| 18                                                                                 | CHB6                  | No Connect       | WD0/             | CHB8                  |
| 19                                                                                 | CHC6                  | No Connect       | CHU6             | CHC8                  |
| 20                                                                                 | PLIM6                 | No Connect       | CHU8             | PLIM8                 |
| 21                                                                                 | MLIM6                 | No Connect       | CHV6             | MLIM8                 |
| 22                                                                                 | HOME6                 | No Connect       | CHV8             | HOME8                 |
| 23                                                                                 | AENA6                 | No Connect       | CHW6             | AENA8                 |
| 24                                                                                 | FAULT6                | No Connect       | CHW8             | FAULT8                |
| 25                                                                                 | PWMATOP6/<br>DAC_CLK6 | No Connect       | CHT6             | PWMATOP8/<br>DAC_CLK8 |
| 26                                                                                 | PWMABOT6/ DAC6A       | No Connect       | CHT8             | PWMABOT8/ DAC8A       |
| 27                                                                                 | PWMBTOP6/<br>DAC_STB6 | No Connect       | USER6            | PWMBTOP8/<br>DAC_STB8 |
| 28                                                                                 | PWMBBOT6/ DAC6B       | No Connect       | USER8            | PWMBBOT8/ DAC8B       |
| 29                                                                                 | PWMCTOP6/ DIR6        | No Connect       | ADC_DAA6         | PWMCTOP8/ DIR8        |
| 30                                                                                 | PWMCBOT6/ PULSE6      | No Connect       | ADC_DAA8         | PWMCBOT8/ PULSE8      |
| 31                                                                                 | GND                   | No Connect       | ADC_DAB6         | GND                   |
| 32                                                                                 | +5V                   | No Connect       | ADC_DAB8         | +5V                   |

The P2A connector provides an alternate path to J11 and J12 for the machine interface connections for channels 5-8. Only the positive signals of complementary pairs are brought out on this connector. For the inputs, the complementary lines are tied to 2.5V on PMAC2. Refer to the J11 and J12 pin descriptions for more detailed information on each pin.

**Note:** Format A for the B-row will be used if jumpers JP1-1 to JP1-32 are removed. This format should be used in a 32-bit VME system. Format B for the B-row will be used if these jumpers connect pins 1 and 2. This format is not compatible with a 32-bit VME system.

## OPTION 1V PIGGYBACK JUMPER SUMMARY

See the Option 1V Piggyback board layout diagram for jumper locations.

| E Point and Physical Layout                                                                                 | Location | Description                                                                                                                                                                                        | Default               |
|-------------------------------------------------------------------------------------------------------------|----------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| <b>JP1-1 to JP1-32</b><br> |          | Jump pins 1 to 2 to use B-row of P2A connector for JMACH pins (not compatible with 32-bit VME).<br><br>Remove jumpers to leave B-row of P2A unconnected to prevent contention with 32-bit VME Bus. | 1-2 jumpers installed |

### E14: SCLK Direction Control

| E Point and Physical Layout                                                                     | Location | Description                                                                                                                                                                                                                                                                                                                                 | Default             |
|-------------------------------------------------------------------------------------------------|----------|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|---------------------|
| <b>E14</b><br> |          | Remove jumper to output SCLK generated in second ASIC on SCLK _56 and SCLK _78, or to control direction by software<br><br>Jump pins 1 to 2 to input SCLK signal for second ASIC on SCLK _78 and output this signal on SCLK _56<br><br>Jump pins 2 to 3 to input SCLK signal for second ASIC on SCLK _56 and output this signal on SCLK _78 | No jumper installed |

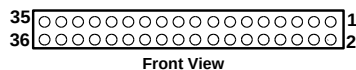


## PMAC2 VME CPU

### Connector Summary

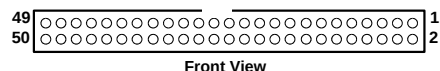
The following paragraphs provide a brief description of each connector on the PMAC2 VME CPUs.

#### J1



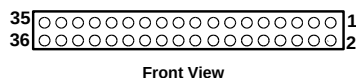
36-pin header on backside for connection to main PMAC/PMAC2 board.

#### J2 (JEXP)



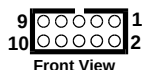
50-pin IDC header for connection to expansion port accessory boards.

#### J3



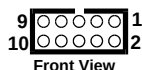
36-pin header on backside for connection to main PMAC/PMAC2 board.

#### J4 (JEXP)



10-pin IDC header for connection to DPRAM on accessory board (PMAC PC) or main PMAC board (PMAC VME or PMAC2 VME).

#### J5 (JTAG/OnCE)



10-pin header for factory use only.

#### J6



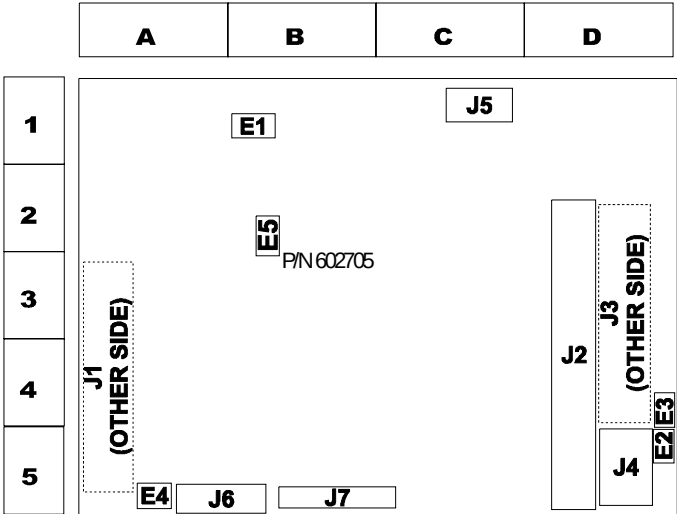
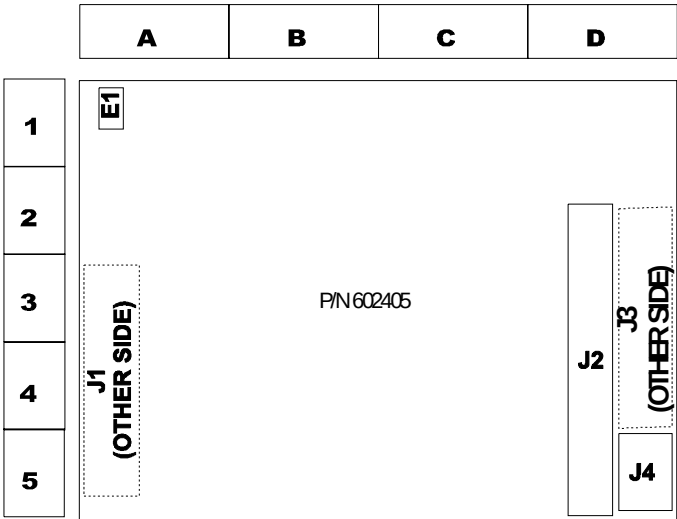
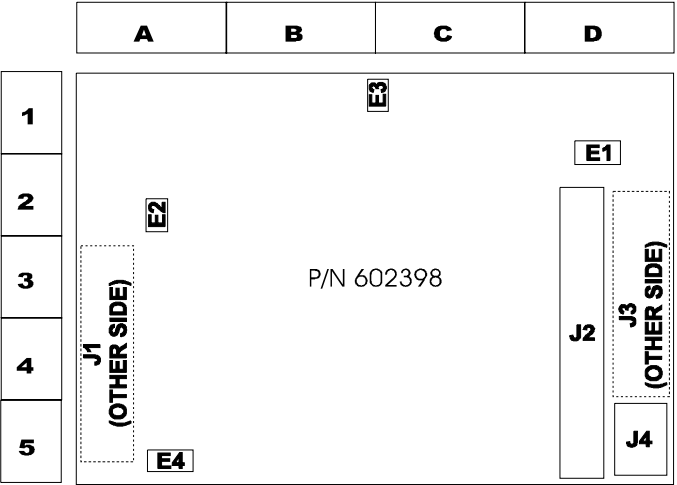
8-pin SIP header for factory use only.

#### J7



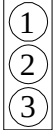
8-pin SIP header for factory use only.

PMAC2 VME CPU Board



## PMAC2 VME CPU Piggyback Board Jumpers

See the PMAC PC CPU Piggyback Board layout diagram for jumper locations.

| E Point and Physical Layout                                                                     | Location                                    | Description                                                                                                                                                             | Default   |
|-------------------------------------------------------------------------------------------------|---------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------|
| <b>E1</b><br>  | D1 (602398)<br>A1 (602405)<br>B1 (602705)   | Remove jumper to enable watchdog timer operation.<br>Jump pins 1 to 2 to disable watchdog timer operation (for test purposes only).                                     | No Jumper |
| <b>E2</b><br>  | A2 (602398)<br>N/A (602405)<br>D5 (602705)  | Remove jumper to disable extended channel addressing (Channels 9-16).<br>Jump pins 1 to 2 to enable extended channel addressing (Channels 9-16).                        | No Jumper |
| <b>E3</b><br>  | C1 (602398)<br>N/A (602405)<br>D4 (602705)  | Remove jumper (or no jumper present) to disable extended channel addressing (Channels 9-16).<br>Jump pins 1 to 2 to enable extended channel addressing (Channels 9-16). | No Jumper |
| <b>E4</b><br>  | A5 (602398)<br>N/A (602405)<br>B1 (602705)  | Boot Enable Jumper.<br>Remove jumper for normal use.<br>Jump pins 1 and 2 for external firmware load (with MAIN board E3 on).                                           | No Jumper |
| <b>E5</b><br> | N/A (602398)<br>N/A (602405)<br>B3 (602705) | Battery-backed RAM Size Select.<br>Jump pins 2 and 3 for supplemental battery-backed memory (Option 16 only).<br>No Jumper if no battery-backed memory.                 | No Jumper |